European Commission

JRC TECHNICAL REPORTS

Raw Materials Information System (RMIS): towards v2.0

An interim progress report & roadmap

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2017

EUR 28526 EN

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JRC106005

EUR 28526 EN

Print	ISBN 978-92-79-66932-3	ISSN 1018-5593	doi:10.2760/05797
PDF	ISBN 978-92-79-66933-0	ISSN 1831-9424	doi:10.2760/119971

Luxembourg: Publications Office of the European Union, 2017

How to cite this report: Manfredi S., Hamor T., Wittmer D., Nuss P., Solar S., Latunussa C.E.L., Tecchio P., Nita V., Vidal, B., Blengini G.A., Mancini L., Torres de Matos C., Ciuta T., Mathieux F., Pennington D. (2017): *Raw Materials Information System (RMIS): Towards v2.0 – An interim progress report & roadmap.*, EUR 28526 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-66933-0, doi:10.2760/119971, JRC106005.

Contents

Abstract

The European Commission's (EC) Raw Materials Initiative (RMI) emphasises that raw materials are essential for the sound and sustainable functioning of Europe's industries and, in a broader context, of Europe's economy and society. The EC is committed to promote the competitiveness of industries related to raw materials. These industries play an important role in many downstream sectors in the European Union (EU) such as construction, chemicals, automotive, aerospace, machinery, pharmacy, equipment, renewable energy devices, and defence. These sectors have a combined added value of around EUR 1,000 billion and provide employment for some 30 million people.

Securing the undistorted supply of raw materials and, in particular, Critical Raw Materials (CRMs) is thus crucial and requires a sound and continuously updated knowledge base, namely the European Union Raw Materials Knowledge Base (EURMKB), as highlighted in the European Innovation Partnership (EIP) on Raw Materials, in its Strategic Implementation Plan (SIP), particularly in the Action area no. II.8.

In this context, and responding to a specific action of the 2015 Circular Economy Communication, the EC's Directorate General (DG) Joint Research Centre (JRC), in close collaboration with DG GROWTH, is advancing its Raw Materials Information System (RMIS). The first version (hereinafter referred to as RMIS 1.0) was launched in March 2015. The advanced RMIS (hereinafter referred to as RMIS 2.0) intends to become an information gateway and knowledge service centre for non-fuel, non-agriculture primary raw materials (e.g. extracted through mining) and secondary raw materials (e.g. recycled, recovered from waste).

RMIS 2.0 will support European Union (EU) policy with tailor-made applications like the Raw Material Scoreboard and CRM assessments, as well as help coordinate other EU level data and information on raw materials. The EU policy support will rely on knowledge from the EURMKB. This knowledge will be made available in the RMIS from different sources. The coordination role will be jointly developed with Member States, industry representatives, and other stakeholders via the so-called Raw Materials Knowledge Gateway (RMKG), which will be the key RMIS' entry point to the EURMKB. The RMKG will also facilitate further coordination activities with a focus on compilation, presentation and application of EU level data.

The official launch of the RMIS 2.0 will take place during the 2017 edition of the "Raw Materials Week" (November 6th to 10th), in Brussels. Towards such launch, this "Interim Progress Report & Roadmap" presents the up-to-date development of the RMIS, including the key policy support knowledge needs that shall be fulfilled, and starts linking identified (EURMKB) knowledge needs with knowledge providers. It also presents foreseen key building blocks for the policy support and several development milestones of the RMIS 2.0 (as of June 2017). The key building blocks focus on a number of themes, including: Critical Raw Materials (CRM) and criticality analysis; Material Flow Analysis (MFA) including the EC Material System Analysis (MSA); the Raw Materials Scoreboard; trade policy aspects; material efficiency and secondary raw materials; sustainability aspects; business & industry; Research & Innovation (R&I); and the policy context.

1. Background and introduction

1.1 Content and structure

This report presents a structured roadmap of development of the second version of the Raw Materials Information System (RMIS), hereafter referred to as RMIS 2.0. It provides and overview of the progresses made with the development of the key thematic blocks of the RMIS as of June 2017, as well as the key development milestones foreseen until approximately the end of 2018.

This report roughly includes the following parts:

- A presentation of the context (both policy- and non-policy-related);
- An overview of the content of the RMIS1.0 as of January 2016;
- A presentation of the identified knowledge needs that the RMIS 2.0 is expected to answer;
- A presentation of the identified foreseen potential knowledge providers;
- A presentation of the overall structure of the RMIS 2.0;
- A description of the thematic blocks of the RMIS 2.0.
- An overview on the foreseen key development milestones.

1.2 The Context

1.2.1 The European Raw Materials sector

As stressed in the EU Raw Materials Initiative (RMI)[1] and further recognized by the Strategic Implementation Plan of the European Innovation Partnership on raw materials (EIP-SIP)[2], raw materials are essential for the sustainable and sound functioning of Europe's industries (EC, 2008).

The European Commission (EC) is committed to promote, within the context of the EU's wider industrial policy, the competitiveness of industries related to raw materials, represented by metal industries, non-metallic minerals industries, minerals and non-energy extractive industries and forest-based industries, manufacturing industries (e.g. automotive industries, chemical industry, pharmacy industry, fertiliser industry, cement industry) (EC, 2017). These industries play an important role in many downstream sectors in Europe such as, e.g., construction, chemicals, automotive, aerospace, machinery, equipment, and renewable energy devices. These sectors have a combined added value of EUR 1,000 billion and provide employment for some 30 million people (EC, 2016). Securing undistorted access to raw materials – and, in particular, Critical Raw Materials (CRM) – is crucial to stimulate investment in innovation and new technologies for a European Industrial Renaissance (EC, 2014).

1.2.2 Policy mandate and drivers

The need for a European Union Raw Materials Knowledge Base (EURMKB) is highlighted in Action area no. II.8 of the 2013 Strategic Implementation Plan (SIP) for the European Innovation Partnership (EIP) on Raw Materials. In addition to the work initiated by DG

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52008DC0699&from=EN

[2] https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/strategic-implementation-plan-sip-0)

GROWTH under the framework of EURMKB[3], and responding to a specific action of the Circular Economy Communication of the EC[4], DG Joint Research Centre (JRC) is continuing to work closely with DG GROWTH to further advance the Commission's Raw Materials Information System (RMIS). The first version of the RMIS was released in 2015 as a permanent website under the JRC Science Hub.

The RMIS aims at providing information on non-fuel, non-agriculture materials (e.g. ores, metals, alloys, industrial minerals and construction materials, biomass) from primary and secondary sources. The information shall be available for the European Union (from regional, national and EU data), provided in a harmonized and standardized way.

1.3 From RMIS 1.0 to RMIS 2.0

In March 2015, the JRC, a Directorate General of the EC, in support of EC policies and working closely with DG GROWTH, launched the RMIS as a permanent website under the JRC Science Hub. This first version (hereinafter referred to as RMIS 1.0) included an overview – mostly of informative nature – of the European Raw Materials Sector in terms of, e.g., legislative context, key stakeholders, EU-funded projects and initiatives. It also included information on most relevant JRC activities supporting – directly or indirectly – the development of a solid knowledge base on raw materials. Annex 1 provides an overview of the content of the RMIS 1.0, as of January 2016.

Further expanding RMIS1.0's scope, RMIS 2.0 aims at fulfilling EU's knowledge and policy needs on raw materials identified by the EC. The RMIS 2.0 shall cover data, information and knowledge on non-fuel, non-agriculture primary and secondary raw materials, and processed materials, covering the entire value chain. The focus of the RMIS 2.0 will be on information available at EU level and context, also considering the fact that material supply chains are partly global. The JRC priority will be given to data required by highlighted EC policy needs, which often come from a large range of sources and rely on many activities in the scope of the EURMKB. The RMIS 2.0 follows a dissemination plan that differentiates target groups according to their data needs:

- RMIS aims at serving the broadest possible stakeholder audience (e.g., metal producers, material scientists, manufacturers, consumers, economists, the public, and decision makers) with general information and data;
- RMIS aims at providing tailor-made information and knowledge to decision-makers, including the European Commission and EU member states. This may include non-public information;
- RMIS aims at providing tailor-made information and knowledge to business stakeholders.

The RMIS 2.0 shall ascertain cooperation between EU level data, information and knowledge providers and the JRC in a structured and prioritised way. Data, information and knowledge will be available from a central website, with the goal of fulfilling knowledge needs and interests of a wide range of users and stakeholders. Compared to the RMIS 1.0, the RMIS 2.0 shall have a stronger focus on providing material-specific, quantitative & spatio-temporal data, information, knowledge and related indicators. The RMIS 2.0 shall allow users with different interests to quickly summarize and visualize information at different stages of the value chain. For this, the RMIS 2.0 is aiming to provide material-specific and country-specific examples in the form of factsheets. This

[3] European Union Raw Materials Knowledge Base (EURMKB), 2017, http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/knowledge-base/index_en.htm

[4] European Commission, 2014, Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions – Towards a Circular Economy: A zero Waste Programme for Europe COM(2015) 614 final (http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52014DC0398)

will form a basis for an extensive coverage of the material flows and stocks within Europe, with data and information that address the needs and interests of stakeholders. Minimum quality levels for the data need to be specified and applied, taking into account the information needs and the raw data available today.

These intermediate steps will allow identifying data and information gaps. The data and information will be assessed systematically, allowing to prioritise the filling of gaps, as well as the quality and accuracy of data, information and knowledge increased.

2 Knowledge needs and providers

2.1 Knowledge needs

In order to facilitate a secure and sustainable supply of raw materials and to better manage resource use, the EU requires – among others – comprehensive knowledge related to the entire raw materials value chain, comprising exploration, extraction, processing/refining (including by-product management), production (including product eco-design), use (e.g. consumption), and end-of-life treatment (re-use and recycling, including waste collection, separation, recovery). Knowledge needs relate to both high-quality data and information. Fulfilling identified knowledge needs is critical to support factual decision- and policy-making in the field of raw materials. Towards this end, the RMIS 2.0 is expected to make substantial steps towards supporting a set of knowledge needs already identified by the Commission (see sub-chapters 2.1.1 to 2.1.4).

In addition to satisfying the knowledge needs for policy support within the EC, the RMIS 2.0 is targeted at providing easy access to structured information to a wide range of stakeholders including the manufacturing industry, extractive industry, recycling industry trade sector, material scientists, economists, academia and education, the wider public, as well as decision/policy makers. This will help to provide knowledge and expertise on the EU raw materials situation to also a larger audience.

2.1.1 Knowledge needs: EU raw materials policy

- Facilitate information and monitoring related to the objectives of the EIP on Raw Materials[5], with a particular emphasis on collection of underlying data and information required for the indicators of the Raw Materials Scoreboard. These indicators are grouped into five thematic clusters, namely: (1) Circular economy & recycling, (2) Raw materials in the global context, (3) Competitiveness & innovation, (4) Framework conditions for mining, and (5) Social & environmental sustainability.
- In line with the Strategic Implementation Plan (SIP) of the EIP on Raw Materials[6], support information related to the security of supply of raw materials, including advancements in the analysis of raw materials criticality, updates of the list of Critical Raw Materials (CRMs), and related methodology development.
- Gather and provide information on material stocks and flows in the EU economy and globally for both primary and secondary raw materials, as re-iterated in the Circular Economy Action Plan[7].

2.1.2 Knowledge needs: raw materials trade

- Strong need to build-up knowledge on trade of raw materials, while also linking this knowledge with the analysis of material flows: data on raw material import/exports (in physical as well as monetary units) and related indicators from material flow accounting (e.g., domestic extraction used, domestic material consumption), and material footprints (i.e., indirect resource requirements));

[5] The European Innovation Partnership on Raw Materials is a stakeholder platform that brings together representatives from industry, public services, academia and NGOs https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/european-innovation-partnership-eip-raw-materials

[6] The Strategic Implementation Plan (SIP) is the EIP's action plan https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/strategic-implementation-plan-sip-0

[7] The Circular Economy Action Plan is http://ec.europa.eu/environment/circular-economy/index_en.htm

- Country-specific information: intermediate and final production, import & export data (e.g., by volume, value, material), import & export restrictions, physical and monetary trade balances, trade commitments;
- Commodity information including analysis of material flows and value chains based on materials flow analysis, position of EU producers in the global value chains, major domestic and foreign suppliers of production components (upstream links) and major domestic and foreign customers (downstream links);
- General macroeconomics of countries, specific financial and fiscal indicators (e.g. cost of labour (or average OPEX in a broader sense) royalty, windfall tax, corporate tax, etc.), sectoral competitiveness figures, trade restrictions and barriers;
- Information related to due diligence and conflict minerals.

2.1.3 Knowledge needs: material efficiency, stocks and flows, recycling

- Information on circularity, including on secondary raw materials inventories, stocks and flows;
- Information, including trends, on raw materials content in selected waste flows, such as WEEE, batteries, end-of-life vehicles and other product categories as well as in mining waste and old landfill sites;
- Information on the quality of secondary resources;
- Expansion and update of existing knowledge on stocks and flows, for example through Materials Flow Analysis (e.g. MSA study);
- Information on recycling potentials.

2.1.4 Knowledge needs: social and environmental sustainability

- For environmental issues, raw materials-specific data are mostly needed in order to assess the environmental performance linked to supply chains for both primary and secondary materials. This can include specific issues such as chemicals use, or acid mine drainage. Equally, it may relate to topics such as climate chain and the provision of material- and sector- specific information;
- Social considerations related to raw materials can equally be addressed for specific operations, materials, and/or countries. They include labour rights issues, human rights and governance, as well as considerations such as contribution of raw materials sectors to the economic development. These relate to considerations of criticality, conflict minerals, and due diligence, amongst others.

2.2 Knowledge providers

Raw materials' knowledge (in terms of both original and re-processed data and information) is being collected and analysed from various sources and by various stakeholders. Knowledge providers include:

- EU documents and studies, e.g. EURMKB[8], KBA[9], MSA[10] & Minventory[11], Raw Materials Scoreboard[12], Criticality analysis[13],

[8] European Union Raw Materials Knowledge Base (EURMKB), 2017, http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/knowledge-base/index_en.htm

[9] DG for Internal Market, Industry, Entrepreneurship and SMEs, 2015, KBA - European Raw Material Knowledge Base Architecture, Final Report, Brussels, 322 p.

[10] European Commission Raw Material System Analysis, https://ec.europa.eu/jrc/en/scientific-tool/msa

[11] European Commission, 2016, Minventory, https://ec.europa.eu/jrc/en/scientific-tool/minventory

- EC-funded projects, e.g. Minerals4EU, MICA, PROSUM, ERECON / EURARE, CRM_Innonet, ERAMIN, SMART GROUND, SCREEN, INTRAW, New Mine, MINATURA2020, MINLEX, MIN-GUIDE, VERAM, STRADE.[14]
- Institutions providing data at European level (e.g., EIT Raw Materials, EuroGeoSurveys - EGS) and with support of the national/regional geological surveys, and other relevant entities collecting raw materials related data and information.
- Stakeholders along the value chain, e.g. industry associations, companies, research institutes, research programs.
- EU Member States and their competent entities.
- Non-EU country entities, e.g. the United States Geological Survey - USGS, Japan Oil Gas and Metals National Corporation - JOGMEC.
- EC services such as DG JRC and DG ESTAT, DG GROWTH, DG ENV, DG TRADE, DG DEVCO, EU Agencies (e.g. European Environment Agency (EEA), EASME).
- International bodies (e.g. UNEP Resource Panel, OECD) are also key sources of data and analyses, and commercial services (e.g. SNL).

Figure 1 provides an overview of example knowledge providers relevant to the RMIS.

Figure 1: Overview of RMIS' knowledge providers (non-exhaustive)

12 European Commission, 2016, Raw Materials Scoreboard, http://bookshop.europa.eu/en/raw-materials-scoreboard-pbET0215541/

13 European Commission, 2015, 'Critical Raw Materials', https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en

14 A comprehensive overview of Horizon 2020 projects relevant in the context of raw materials is provided in the "Bi-annual report, 1st semester 2017" by the Executive Agency for Small and Medium-sized Enterprises (EASME). (Not available on line at the time of writing).

However, this knowledge is often from a large number of sources, may not be in the form required, may not be regularly updated, and there can be many gaps, which limits the possibility of using it for more informed and factual decision- and policy-making. In this respect, RMIS has the ambition to highlight key gaps, and facilitate coordination of harmonization. Equally, most projects are funded for finite periods, after which the outcomes may be less accessible, thus discontinuing the provision and maintenance of usable data and information. RMIS has a mandate to incorporate, archive and serve this information in a harmonized and user-friendly way.

Annex 2 provides an overview of selected projects and initiatives relevant to the RMIS and identified as potential data sources. Annex 3 shows the timelines of these projects and initiatives.[15]

2.3 Linking knowledge providers to the RMIS website and visualisation of data sources

The RMIS aims to support the broad range of EU policy knowledge needs of, e.g., the Raw Materials Scoreboard, Critical Raw Materials (CRM) assessment, trade negotiations, and the Material System Analysis (MSA). Various data and information are being collected in the process of developing the policy-related outputs such as the EU CRM assessment, RM Scoreboard, RMIS trade module, and MSA. In order to better integrate relevant data sources, utilize data overlaps between policy-related outputs and enable better integration into the RMIS, a database development of the RMIS is foreseen. Due to its system-wide perspective on raw materials issues (encompassing all life-cycle stages of a material), the MSA provides an overarching data structure that could be based inside the RMIS database core to collect, systematically arrange (e.g. by life-cycle stage), store, and provide data for policy-related knowledge needs on raw materials.

The RMIS is envisaged to include relevant sets of data from the both EU and external knowledge providers (e.g., UN, OECD, USGS) and EU internal data sources (e.g., Eurostat and H2020 projects). Among these, there are also synthesized data sets generated specifically to satisfy the data needs of EU policy dossiers (e.g., Raw Materials Scoreboard, Critical Raw Materials (CRM) Assessment, Trade, and the Material System Analysis (MSA) study) (Figure 2).

[15] For a more exhaustive and up-to-date overview and analysis of H2020 projects relevant in the raw materials context, reference shall be made to the "Bi-annual report, 1st semester 2017" by the Executive Agency for Small and Medium-sized Enterprises (EASME). (Not available on line at the time of writing).

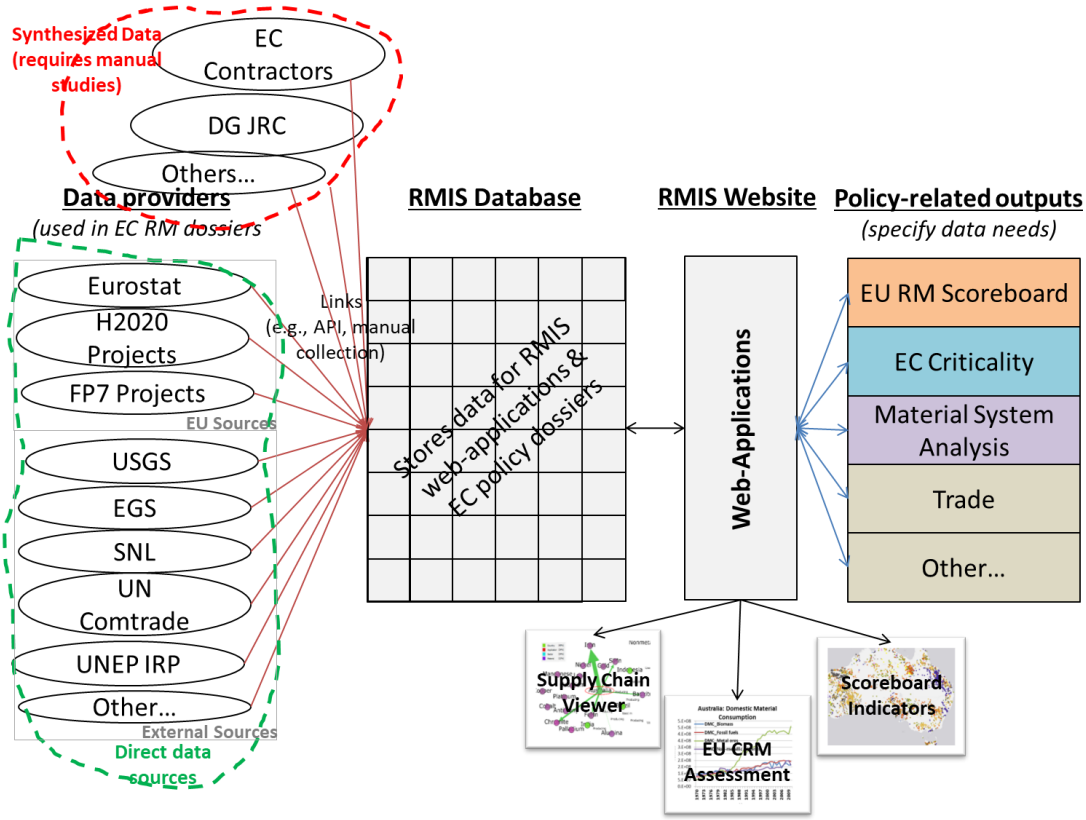

Figure 2: Schematic figure presenting how the RMIS database links data providers (sources) to the RMIS website

Figure 3 presents that some data sources such as Eurostat (e.g., COMEXT, PRODCOM, EW-MFA), European Commission (EC) (various EC reports), BGS, USGS) represent key data sources for three of the key policy-related outputs (indicated by their node size based on connectivity) that will be present at the launch of the RMIS 2.0. The figure also illustrates that the CRM and MSA assessments are highly interconnected concerning the data sources they use (i.e. various data overlaps and therefore synergies exist), while the Scoreboard is based also on some additional data sources and represents, hence, partly its own data cluster.

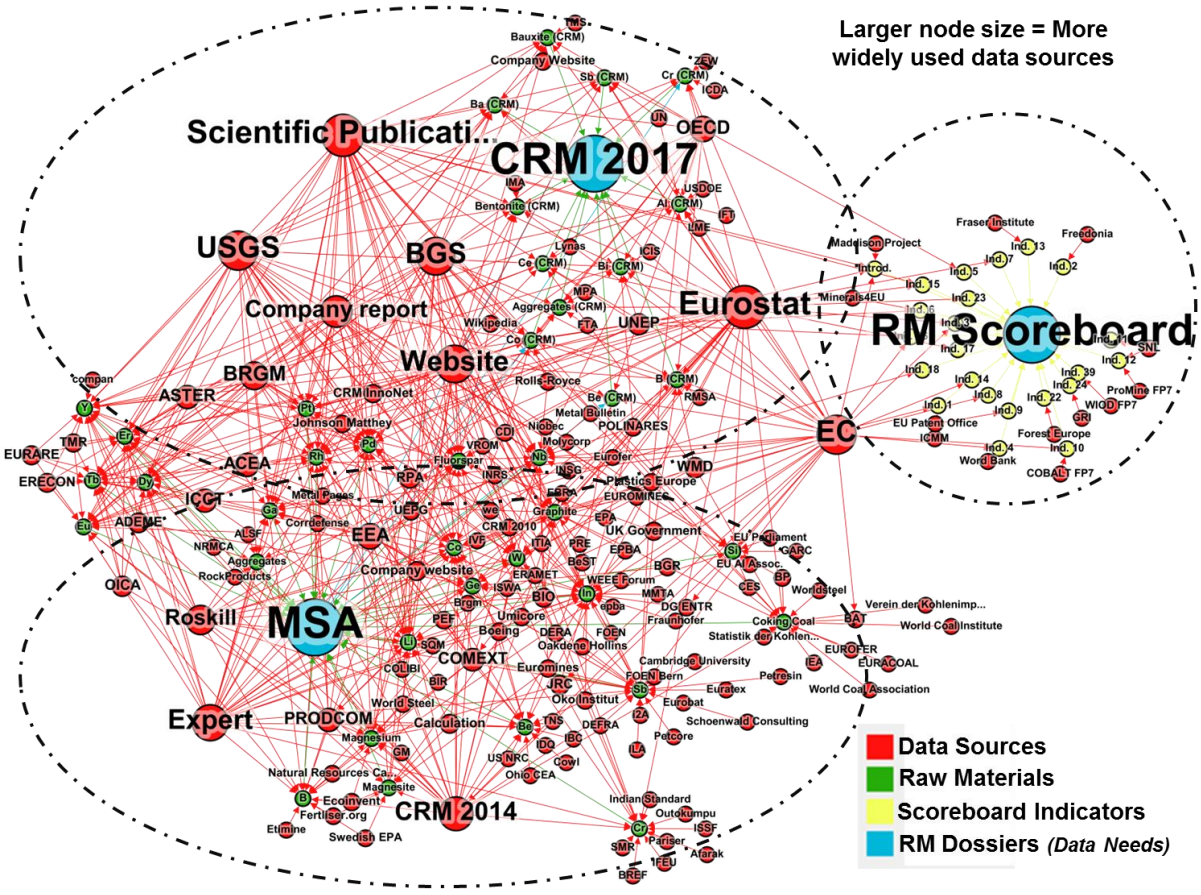

Figure 3: Network visualization of data sources (red-colored nodes) and how they are linked to raw materials to the three key policy-related outputs included at the launch of RMIS2.0 (i.e., 2015 MSA study, 2017 CRM assessment, and 2016 RM Scoreboard shown as blue-colored nodes)[16]

[16] Only a subset of raw materials (green nodes) of the forthcoming 2017 CRM assessment are shown in the figure. For the RM Scoreboard, individual indicators to which the data sources are linked are visualized as yellow nodes.

3 RMIS 2.0: structure and content

3.1 General design concepts

The RMIS is an information system related to raw materials in the wider sense. The RMIS structure supports the collection, organization, storage and communication of information on raw materials, and to a certain degree on materials, and components and products made of them. The RMIS website is the dedicated website that communicates the RMIS content to the public. While this chapter (3.1) provides some general insights on the RMIS structure and setting, chapters 3.2 and 3.3 present a more detail description of the content that is foreseen for inclusion in the RMIS website.

The content and some of the functional elements of the website menu at its different levels are going to correspond implicitly with the major EU policy-related drivers (and their implementing priority actions), such as:

- Raw Material Initiative (RMI),
- European Innovation Partnership on Raw Materials (EIP-RM),
- Resource Efficiency (e.g. EU Resource Efficiency Roadmap),
- Circular Economy, and
- Sustainable Development,
- Common Security and Defence.

Another organization of the information and search facility of RMIS 2.0 will be along the raw materials value chain and its overarching "horizontal" aspects (e.g. public awareness, education, global information sources, JRC's in-house science and technology services, etc.). Annex 4 provides an overview of the raw materials supply chain viewer in the RMIS 2.0.

Policy documents do have overlapping, synergetic objectives and implementation priorities. On the contrary, potential customers (website users) and stakeholder groups (EU and Member States decision makers, industry representatives, international and domestic investors, academia (research and education entities) and interested public may have differing interests and foci. To properly address such differing interests, the RMIS 2.0 will establish a flexible system architecture (and, thus, data architecture) in order to provide the potential functional links among the website mask menu entries, the elements of the policy action areas, the stages of the value chain and the information set modules. In this respect, RMIS 2.0 could benefit from e.g. the intelligent knowledge service application to be developed by the MICA project by the end of 2017. The above expectations require the planning to be set in a matrix system with the indication of multiple interlinkages and tagging (labelling or indexing) of the individual elements. Figure 4 provides a visualisation of the connections among key policy drivers, stakeholders and information within RMIS.

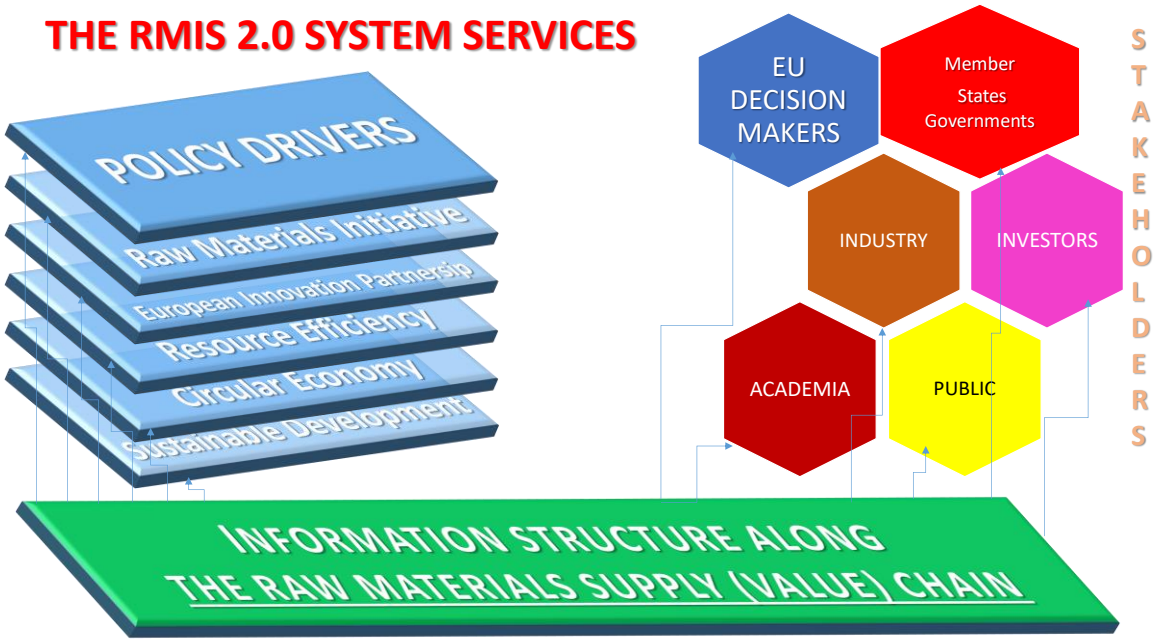

Figure 4: RMIS 2.0 information basis structure, major policy drivers, and stakeholder (customer) groups

With respect to its content, RMIS 2.0 is attempting to supply many but not all planned functions with information. This means, for example, that the international dimension at selected raw material factsheets and at trade data will be treated in RMIS 2.0, but country profiles for most non-EU countries will most likely not be prepared by the time of the RMIS 2.0 launch (Q4 o 2017)..

The front-end layout of the RMIS website will be based on a modern *semi-flat design*. This design helps the visitor understand the content more quickly, and adding some elements of depth can bring it to life. Inside this layout, the content elements will be displayed using a "tile design" (Figure 5). Individual tiles help distribute information in a visual way so the visitors can easily consume bite-sized pieces of content without being overwhelmed. This also helps to keep the homepage feeling clean and organized, without relying on plethoric text. Moreover, using this design on the RMIS website can help highlight multiple elements, applications or blocks side-by-side.

Regarding the interaction experience, the website layout will adapt the *Responsive Web Design* (RWD) approach. RWD provides an optimal viewing and interaction experience—easy reading and navigation with a minimum of resizing, panning, and scrolling—across a wide range of devices (desktops, tablets, phones). RWD relies on CSS3 and HTML5 to auto resize, hide, shrink, enlarge, or move the content to make it look good on any screen of any device.

3.2 Homepage overview

As anticipated, the website's main menu will allow straightforward and intuitive access to the RMIS' content through a limited number of overarching thematic tiles (Figure 5). Each of these tiles includes and coherently integrates RM-knowledge related to a certain main topic. By pointing the cursor on a given tile, users can visualise a short summary

and overview of the content of the tile, as well as access to the second and third menu levels within the tile. Beyond the third level, the fourth level is the broad set of further pages that are mentioned and hyperlinked internally in the first three level content. Chapter 3.3 presents the themes foreseen to be included in each tile of the main menu, as of June 16th, 2017.

Figure 5: RMIS 2.0 menu layout example

3.3 Content of thematic tiles

3.3.1 Overview

The "Overview" tile of the RMIS 2.0 main menu will give users an introduction on the policy context, mandate, goal and scope of the RMIS 2.0, as well as a presentation of key knowledge needs (i.e. the knowledge-gaps that the RMIS is expected to fill) and knowledge providers (i.e. the groups, projects, organisations that will help gather such knowledge). The "Overview" tile will also include a 'news & events' section, as well as present the 'raw materials value chain'. The latter, will allow users to access information that is divided into the following blocks: abiotic/biotic primary raw materials, fabrication & production, consumption, waste management. It will also provide access to so-called "horizontal topics" related to e.g. trade, sustainability, indicators, legislation, etc.

3.3.2 Policy & legislation

The "Policy & legislation" tile of the RMIS 2.0 main menu will provide an overview of the most important policy fields and documents (Commission Communications in most cases) that directly support the development of the RMIS (e.g. the Circular Economy Action Plan) or of the European knowledge base on raw materials (e.g. the European Raw Material Initiative), as well as of those that are anyway relevant in the context of the RMIS development. It will also include an overview of selected relevant international conventions and initiatives, EU Treaties and secondary Community legislation, as well as links to relevant national legislation at the country profiles section.

3.3.3 Terminology & library

The "Terminology & library" tile of the RMIS 2.0 main menu will provide a glossary of most relevant terms/concepts used in the raw materials context based on EU legislation, international standards and H2020 consortia's glossaries, an up-to-date searchable library of major reports to be later developed into a metadatabase, as well as a section focused on harmonisation aspects in the RM sector such as harmonisation of RM classification, trade classes, extractive waste facility classes, landfill classes, etc.

Annex 7 provides additional insight on the foreseen structure and content of the RMIS 2.0 library

3.3.4 Critical Raw Materials

The "critical raw materials" tile of the RMIS 2.0 main menu will provide insights on the present and past lists of CRMs for the EU, with emphasis on the JRC role to continuously improving the methodology to identify CRMs, as well as a structured and facilitated access to the detailed potentially critical raw materials factsheets. It will furthermore provide information on related considerations, such as resilience and sector-specific analyses.

BOX – Critical Raw Materials

Within the Raw Materials Initiative, particular attention is given to "Critical Raw Materials"(CRMs). 'CRMs' are raw materials of a high importance to the economy of the Union and whose supply is associated with a high risk. In the 2011 Communication on raw materials, the Commission formally adopted a list of 14 'critical' raw materials and made a political commitment in the 2011 Communication on the Raw Materials Initiative to update the list at least every three years. The latest Commission Communication of 26 May 2014 included a revised list of 20 critical raw materials for the EU[17].

The purpose of the list is to incentivise the European production of CRMs and facilitate the launching of new mining and recycling activities. The list is also being used to help prioritise needs and actions. For example, it serves as a supporting element when negotiating trade agreements, drafting legislation, challenging trade distortion measures or promoting research and innovation. The list of CRMs serves also as a basis for EU and national policy measures in relation to (critical) raw materials.

[17] European Commission, 2015, 'Critical Raw Materials', (https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en)

The report on CRMs in 2014 (and 2011) also included two annexes with fact sheets of all the assessed raw materials i.e. extended fact sheets for the critical raw materials and limited ones for the non-critical raw materials (not shown in this tile of the RMIS).

3.3.5 Raw Materials Scoreboard & other monitoring systems

The "Raw Materials Scoreboard & other monitoring system" tile of the RMIS 2.0 main menu will provide access to the 2016 Raw Materials Scoreboard[18] content. This is done through a dynamic application, as described in section 4.3.5.

This tile will also present knowledge from other scoreboards and monitoring systems including the Resource Efficiency Scoreboard, the European Innovation Scoreboard, and the framework of indicators being developed for monitoring progresses towards a more Circular Economy. Furthermore, it will also include information regarding the monitoring of the EIP Raw Materials (e.g. Strategic Implementation Plan, annual monitoring reports).

BOX – The Raw Materials Scoreboard

The EU Raw Materials Scoreboard, a cornerstone of the EU's knowledge base on raw materials[19], is an integral part of the RMIS. The Scoreboard presents the best available data on the main challenges of raw materials production in the EU along the entire raw materials value chain, and will be updated with the support of the JRC on a regular basis (two years).

The Scoreboard is meant to assess the progress towards the objectives of the EIP Raw Materials and towards a more circular economy (as stated in the recently adopted Circular Economy Action Plan[20]), where actions are planned for developing a stronger EU market for secondary raw materials, in order to boost global competitiveness, foster sustainable economic growth and generate new jobs via the use of resources in a more sustainable way. It also complements the Resource Efficient Europe[21] policy objectives and its Resource Efficiency Scoreboard[22]. In this context, the data presented in the Scoreboard will be permanent elements of RMIS on a long-term perspective.

The first edition of the EU Raw Materials Scoreboard[23], released in July 2016, was developed by DG GROW with the support of DG JRC, and in close interaction with an *ad-hoc* working group (AHWG) of public and private stakeholders and policy makers (around 30 experts representing a balanced range of interests). The AHWG contributed to the Scoreboard during many steps of the development cycle, from indicators selection to the

18 European Commission, 2016, 'Raw Materials Scoreboard', http://bookshop.europa.eu/en/raw-materials-scoreboard-pbET0215541/

19 European Union Raw Materials Knowledge Base (EURMKB), https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/knowledge-base_en

20 European Commission, 2015, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Closing the loop - An EU action plan for the Circular Economy, COM(2015) 614 final, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614)

21 European Commission, 2011, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Roadmap to a Resource Efficient Europe, COM(2011) 0571 final, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2011:0571:FIN)

22 The EU Resource Efficiency Scoreboard, 2015, http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/pdf/EU%20Resource%20Efficiency%20Scoreboard%202015.pdf

23 European Commission, 2016, 'Raw Materials Scoreboard', http://bookshop.europa.eu/en/raw-materials-scoreboard-pbET0215541/

fine-tuning of the final information and data analyses.

The 2016 version of the Raw Materials Scoreboard consists of 24 analyses (also referred as "indicators" or "indicator fiches") grouped into five thematic clusters (see **Error! Reference source not found.**). In most cases, indicators can be associated to specific stages of the supply chain. The Scoreboard also highlights the importance of raw materials to the EU economy and to jobs and growth in particular. For example, looking at the metals value chain the Scoreboard finds that more than 11 million jobs in sectors such as electronics manufacturing, automotive and machinery (equal to 40 % of the jobs and value added from the EU's entire manufacturing sector) depend on the secure supply of raw materials.

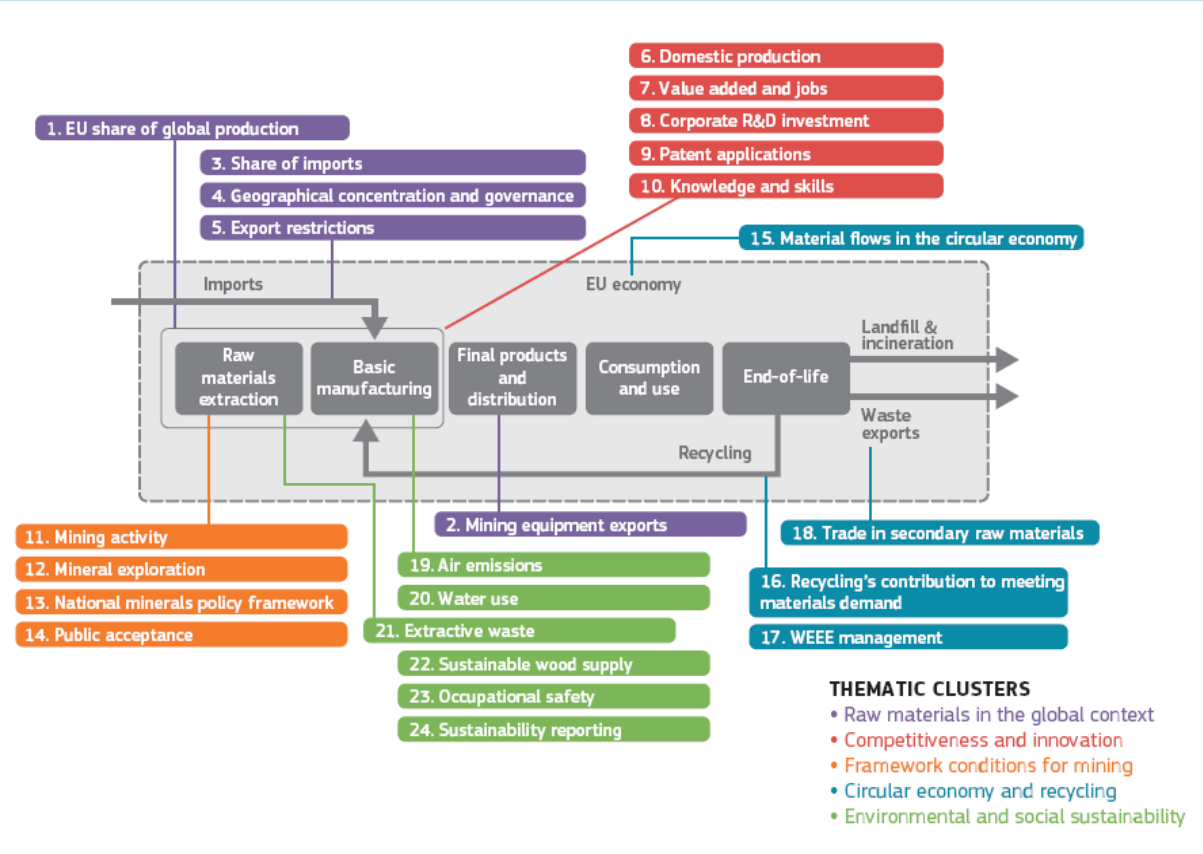

Figure 6: Structure of the 2016 Raw Materials Scoreboard

Since February 2017, the Scoreboard has been also partially integrated within the RMIS[24].

The 2018 edition of the Raw Materials Scoreboard is being currently developed and is expected to be published by the first half of 2018. It will include an update, and sometimes a more in depth data analysis, of the 2016 Scoreboard anlayses. This includes, depending on the indicator, simple data updates, changes in the data display and the inclusion of more cross-country (EU and non-EU countries) and cross-sector comparisons. In addition, data sources will change for some indicators and some new indicators will likely be added, some of which will complete data related to social and economic aspects. The explanatory text associated to each indicator will be also reviewed, including more complete descriptions of the patterns and trends observed in the data. As it was done for the first Scoreboard edition, the 2018 edition will be

[24] European Commission, 2016, Raw Materials Information System – Scoreboard, http://rmis.jrc.ec.europa.eu/Scoreboard/

developed in close consultation and involvement of the AHWG and Sherpas group.

3.3.6 Secondary raw materials (SRMs) and the Circular Economy

The "Secondary raw materials (SRMs) and the Circular Economy" tile of the RMIS 2.0 main menu emphasises the role and importance of related activities for the supply of raw materials for the EU economy. To this end, it will provide access to knowledge on e.g. data and monitoring indicators of SRMs (e.g. data sources, tools and assessment methods), how SRMs are tackled in the five "priority areas" indicated by the Circular Economy Action Plan (in particular, CRM and construction & demolition), as well as an analysis of SRMs in other specific industry sectors.

3.3.7 Environmental & social sustainability

The "Environmental & social sustainability" tile of the RMIS 2.0 main menu will focus on the environmental and social sustainability considerations of raw materials supply chains. With respect to environmental sustainability, this section will provide information and/or data related to e.g. emissions of greenhouse gases and pollutants by the different extractive and processing activities, water use and impacts on land and biodiversity. Similarly, for the social dimension, this section will provide information on e.g. employment, conflict minerals, due diligence, occupational health and safety, governance and integrity. Both environmental and social sustainability sections will link to the environmental and social information included under the "Country profiles" (tile n.12).

3.3.8 Economics & trade

The "Economics & trade" tile of the RMIS 2.0 main menu will allow users to access information relative to trade performance (e.g. import/export of raw materials at country level), global production of primary and secondary raw materials, as well as knowledge on foreign investments, trade promotion and restrictiveness. Both economics and trade sections will partially feed into the economics and trade sub-sections included under the "Country profiles" (tile n.11).

Chapter 4.3.4 and Annex 7 provide additional insight on the foreseen structure and content of the "economics & trade" section in the RMIS 2.0.

BOX – Trade in RMIS 2.0

Through the process of economic globalisation, the economies of industrial societies increasingly rely on imports to satisfy their material needs and the revenue generated from export of highly manufactured technology goods. Trade related information is crucial in determining a country's position in the value chain and its competitiveness. It is relevant to a wide range of stakeholders and can strengthen the systemic understanding of raw materials supply chains.

The aim of the RMIS block on trade is to build a trade related database, which will serve as basis for developing production- and trade-related indicators, as well as country- and product level visualisation tools specific to non-fuel and non-agriculture raw materials.

Data resulting from this analysis will contribute to EU policy making and strengthen the international dimension of the Raw Materials Strategy, the EIP on Raw Materials and, in

consequence contribute an important building block to the EU Trade for All Strategy, the EU economic diplomacy and EU Global Strategy. The international dimension of the Raw Materials Strategy aims to ensure a level playing field in access to resources in third countries and is based on two principles: co-operation and trade. It aims to ensure effective coordination and coherence among EU external policies (external relations, trade, development) and the industrial policy. It also means coordination at EU level in the management of EU strategic partnerships[25] and policy dialogues with third partner countries, emerging economies and developing countries rich in mineral resources and their regional groupings as well in pluri- and multi-lateral forums.

3.3.9 Industry & innovation

The "industry & innovation" tile of the RMIS 2.0 will be of particular relevance for investors, innovators and industry in general in the context of available support options (including funding) and framework conditions in Europe, with a hyperlink to the RMIS country profiles application. It may help saving financial and human resources for interested stakeholders, especially SMEs with limited capacities. In this way, it may contribute to the re-industrialization principle and to undistorted competition objectives. However, the national and regional level resolution of certain topics of this chapter (e.g. national funding facilities, full coverage of fiscal waivers, etc.) is foreseen at stage RMIS 3.0. This tile will also provide an overview of the most important R&I institutions/mechanisms in the RM context. This also includes European R&I funding schemes such as Horizon 2020 and FP7, as well as examples of international co-operation and future foresight studies.

3.3.10 Raw materials' profiles & supply chains

The "Raw materials' profiles & supply chains" tile of the RMIS 2.0 main menu will provide access to quantitative and qualitative knowledge relative to the supply chains of nearly 80 raw materials. Users can choose whether to sort the available raw materials in three ways: alphabetically (default option), from the expanded periodic table of elements, or per-group (e.g. precious, rare & high-tech metals / base metals / industrial & construction minerals / biotic raw materials / others). This tile will be linked to the ones on supply chains, environmental and social aspects, trade and economics, innovation and industry and country profiles, in order to ensure consistency at the level of EC RMIS. Annex 5 provides additional insight on the foreseen structure and content of the raw materials' profiles in the RMIS 2.0

This tile also provides access to data and knowledge related to Material Flow Analysis (MFA) and, in particular, the Material System Analysis (MSA) which represents MFAs for various materials at the level of the Eu-28. The MSA project was initiated by DG GROW and from January 2017 is run, maintained, and expanded by the JRC. Included in this tile is also the "supply chain viewer", which will allows users to view simple raw material supply chains consisting of raw materials, countries, sectors, and product applications. Annex 4 provides additional information on the foreseen structure and content of the RMIS 2.0' supply chain viewer.

BOX – Material System Analysis (MSA) & Minventory

The challenge of securing access to raw materials (metals and minerals) has received public attention in Europe. In order to successfully cope with the challenge relevant and

[25] EU strategic partners include Brazil, Canada, China, India, Japan, Russia, and US.

adequate information is needed. To this end, in 2015, DG GROW has finalised two studies containing valuable data: 1) MSA study: "Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials"[26]: and 2) "Minventory: EU raw materials statistics on resources and reserves study"[27]. MSA study is essential to understand the stocks and flows of raw materials throughout the whole value chain. While the Materials System Analysis (MSA) looks at stocks and flows across the whole material value chain, the Minventory covers metadata on different stocks.

The results of MSA are building blocks of the European Union Raw Materials Knowledge Base (EURMKB). In the context of the 2016 Administrative Arrangement between DG GROW and DG JRC, DG JRC will maintain, update and extend the MSA and keep the essential parts of Minventory, and integrate them within the RMIS. Currently the outcomes of both studies are placed on the DG JRC Science Hub website, but are also accessible via the RMIS.

The MSA study built knowledge and understanding of Europe's critical raw materials' flows. A data inventory of these material flows in industry and society for decision-making, a Material System Analysis (MSA) for 28 materials[28] was developed. More precisely, the project provided:

- A complete overview of existing data sources adapted or workable for MSA in Europe, with a specific examination of the Eurostat data base on trade of goods from the viewpoint of its usability for MSA;
- A detailed methodology on establishing MSA in the European Union;
- MSA for the 28 studied materials, with detailed data sources, assumptions and calculations and with main data gaps filled with experts' inputs gathered through direct consultations and organisation of workshops; and
- Recommendations for the maintenance and update of the MSA.

The Minventory study further analysed the availability of metadata on resources and reserves of mineral raw materials. The Minventory study has characterised the metadata held in Member States and their offshore dependencies, and 13 neighbouring European countries concerning stocks of:

- primary raw materials i.e. geological deposits of minerals and ores (land-based and marine);
- secondary raw materials i.e. materials consigned as waste having been once used, but which might be reprocessed for re-use; and (as a scoping exercise only);
- 'in use' materials i.e. materials embedded in products and infrastructure which might, in future, become secondary raw materials.

3.3.11 Country profiles

The "Country profile" tile of the RMIS 2.0 will provide access to country specific information related to raw materials and their supply chains. Country specific information will indicatively be structured in the following groups: reserves & production, material flows & stocks, trade, regulatory framework, environmental dimension, social dimension. Profiles will be completed in accordance to knowledge priorities.

[26] European Commission, 2015, Material System Analysis study – 'Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials' https://ec.europa.eu/assets/jrc/msa/images/msa_final_report.pdf

[27] European Commission, 2015, Minventory: EU raw materials statistics on resources and reserves study', https://ec.europa.eu/docsroom/documents/10224/attachments/1/translations/en/renditions/pdf

[28] 26 critical raw materials from the extended list from 2014, plus lithium, and aggregates

3.3.12 Raw Materials Knowledge Gateway (RMKG)

The "Raw Materials Knowledge Gateway" (RMKG) tile of the RMIS 2.0 will provide an overview of relevant knowledge in the broad context of the National, European and International raw materials sector. It is foreseen that, based on e.g. a template developed by the JRC, the content of this tile will be progressively provided by:

- National level data providers, within and outside Europe;
- EU level data providers, such as EU institutions, Eurogeosurveys, EU industry associations; where linking with major pan-European thematic information services such as e.g. EGDI, EPOS, EMODNET, selected JRC Knowledge Centres, etc. is foreseen.
- Global level data providers, such as international organisations, global data services, global industry associations;

The idea is to engage/involve as much as possible such relevant knowledge providers into the RMIS, as a central European gateway of knowledge on raw materials. The RMIS 2.0 will also facilitate knowledge coordination & harmonization, as well as other joint activities. In this way, other data providers will be able to actively contribute to consolidating and expanding such knowledge. In turn, this knowledge will be further used in support of, and complementing, other important RMIS outputs, such as the criticality analysis, MSA analysis and the RM Scoreboard.

4 RMIS cooperation and development milestones

This chapter provides an overview of the scope and concept of the RMIS cooperation, as well as the overall RMIS development and the related milestones, as foreseen until end of 2018. Due to the knowledge management component, these milestones directly link to the knowledge providers and knowledge needs identified in Chapter 2.

Milestones include not only the launch of the key thematic blocks that will be included in the RMIS 2.0 at launch, but also events whose overarching aims is to establish efficient and fruitful long-term partnerships with the relevant stakeholders in the raw materials context.

4.1 Background

The European Union Raw Materials Knowledge Base (EURMKB), described in detail in Action Area n° II.8 in the Strategic Implementation Plan of the European Innovation Partnership on Raw Materials (EIP-SIP), aims at providing EU level data and information on raw materials from different sources.

During the past years, a lot of data, information and knowledge was collected by the Member States and their entities, by the EC as well as by numerous research and other projects and programmes (including those financed by EU). However, much of these outcomes are scattered across various websites and databases, heterogeneous in their data structure, and/or not repeated over time (one-off studies). This makes it impossible to reach the EURMKB target of providing and maintaining a harmonised knowledge base at EU level.

Hence, the EURMKB does not have to be built from scratch, but builds on a variety of projects, programs, initiatives on EU and Member State level. **A stronger coordination of the activities related to improve raw materials data and information on EU level[29] is needed to support a systematic compilation and harmonisation of the data.** First steps in this direction have already taken place, while an explicit straightforward knowledge management strategy would be required to establish concrete targets of the future scope and function of the EURMKB.

4.2 Cooperation and Dissemination

4.2.1 Overview

In addition to the providing information to support EU raw materials policy, the RMIS 2.0 has also a coordinating role of EURMKB, in order to exploit the wealth of information contained in other data providers in order to the benefit of the European Union and its partners.

In a first step, RMIS will reinforce accessibility to the relevant data providers by acting as a central focal point of the EURMKB. This is enabled by the Raw Materials Knowledge Gateway (RMKG), the RMIS' gateway to the EURMKB. The concept and structure of the RMKG will be elaborated in a cooperative way among JRC and the key stakeholders of the EURMKB.

[29] European Commission, 2013, 'The Strategic Implementation Plan (SIP); EIP's action plan' (https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/strategic-implementation-plan-sip-0).

Providing a unified access to the EURMKB via the RMKG will lead to an increased visibility of relevant data to the various stakeholders. This implies also an increased responsibility to support advanced analyses and the interpretation of the data and information. Given the fact that the EURMKB is the product developed by various sectorial and scientific communities, cooperation, communication and dissemination are of high importance. The RMIS shall be in charge of the coordination and management of the utilisation of the EURMKB in the above-described context.

These complementary activities related to the coordinating role of JRC may include supporting existing activities on:

(a) exchange of data and information among data providers,

(b) developing and disseminating harmonized or standardized EU level data,

(c) highlighting gaps

(d) advancing mandatory (INSPIRE) or voluntary terminology or definitions,

(e) stakeholder platform(s) that enable actual and potential users of the RMIS to formulate information needs,

(f) the promotion of products (such as Raw Materials Scoreboard, Minerals Yearbook, maps of deposits, access to details on EU /and MS/ level, ….).

In addition, the RMIS 2.0 will host relevant data and information generated as outcomes from already finished EU projects with its library, and integrate the data, if considered effective.

4.2.2 Cooperation Concept

The Raw Material Information System (RMIS) also acts as a central focal point of EURMKB / information service that is capable:

- to give access to data and information from various data sources, raw data and processed data, and
- to support coordination for harmonization / standardization of data, information and knowledge.

The RMIS has the function to facilitate access to raw material data providers that serve the other needs of data, information and knowledge by the multiple data users. In order to reach this, the RMIS needs to provide a data hub with a tailor-made structure to provide an adequate performance.

This task of the RMIS is complementary to the roles described in chapters 2 and 3. JRC will through RMIS 2.0 help to coordinate the provision of, and needs for, data and information needs of the EU. For this purpose, the RMIS provides a central focal (entry) point to data providers. JRC plans to help coordinate to some degree national level data providers, more the EU level providers, and exchange on the input/output side with the rest of the world (RoW) data providers. Initially, a first step will be to identify info that is available and to bring together key representatives.

The RMIS should be capable to:

- Promote access to external data , via links embedded in thematic websites of the RMIS, potentially also from a central "data content"
- Facilitate relevant data quality criteria, including
    - A harmonised use of terminology, related to the *Glossary*

- Adequate level of metadata, including an indication on uncertainties related to the data (meta information on data)

- Provide sufficient context to the data accessible from the RMIS, to enable the users a proper understanding of available data sets.

The RMIS will facilitate the provision of such information in a harmonised way, that makes it easier to compare different sets of data and information (from different or the same data provider). In order to be able to do so, proper and secure cooperation between the RMIS team and the diverse data providers is required. Networks of data providers will be established.

The management of the networks and their data flows (data and metadata) to the RMIS is crucial in order to provide the data from the network to the RMIS users via the Raw Materials Knowledge Gateway (RMKG).

The outcome of this is the definition of a coordination role of the RMIS team that, in the long-term may ensure:

- the organisation of a well-functioning network, with well-defined roles, responsibilities, commitments and rights of data providers (e.g. via a MoU or similar)
- the setting basic standards for the quality of data sets. This will be an iterative process that requires the cooperation with the network, but will be driven by RMIS.
- The integration of data in a way that is compatible with the presentation of existing RMIS and other contents, including the apps and products, and relationships between them are understood intuitively.
- In the long term, the goal is that users of the RMIS receive data, information and knowledge from the comprehensive EURMKB in a harmonised way.

4.2.3 Dissemination: Workshop on raw materials supply

The workshop **"***Raw Materials Supply: from Criticality to Resilience – A JRC exploratory workshop on the supply of raw materials*" took place on 12 January 2017 at the JRC in Ispra (VA), Italy. This exploratory workshop discussed the inventory of raw materials knowledge within JRC, ways to intensify cooperation across Directorates and their Units, and the role of the RMIS as provider and manager of data, information and knowledge on raw materials. The workshop addressed primarily JRC units as possible data providers and users, but also identified the important roles of other European institutions like the EIT on Raw Materials, EuroGeoSurveys, and the European Investment Bank.

The ongoing globalization and economic processes typically result in a growing dependence on specific commodity suppliers. Actually, the secure and sustainable supply of raw materials to the EU industry has been increasingly challenged over the past years. High market concentration, export restrictions and distinct price volatilities, put the security of supply by mineral and biogenic raw materials back on the political agenda. Moreover, increasing import dependency for raw materials in EU can result in a shifting of environmental and social impacts to third countries, where they have lower standards and poorer governance. Hence, there is a strong need for stocktaking and analyses of raw mineral production, international trade measures and agreements, and other actions improving the security and sustainability of supply that is a required by the EU industry when generating added value and jobs.

The Raw Material Initiative recognises these needs for action, while the European Innovation Partnership on Raw Materials with its Strategic Implementation Plan has fostered diverse innovative solutions to help overcome them. The European Union Raw

Material Knowledge Base (EURMKB), as part of SIP, aims at providing the data, information and knowledge needed to serve the policy and other needs. The JRC Raw Material Information System (RMIS) that is currently developed has a central role within the EURMKB. The JRC develops the RMIS 2.0 by means of the plurality of knowledge and intelligence on raw materials dispersed within and outside JRC.

By mapping the relevant JRC units and institutions, this workshop revealed extensive activities, data and information on the supply of raw materials, which is usable to prepare a DG JRC inventory of potential contributions on the raw material supply to the joint effort RMIS 2.0. Coordination and cooperation shall be advanced to create synergies, leading to harmonised and validated data, information and knowledge, and their increased sub sequential application. It was confirmed that it is needful to exceed criticality assessments by activities that enhance the resilience in the EU industry, and methods are required for assessing resilience within/across raw material supply chains.

4.2.4 Dissemination: first international workshop on the EU RMIS

The aim of the workshop is (a) stakeholders' consultation on Raw Materials Information System (RMIS) that would include (b) presentation on the RMIS progress and its foreseen development milestones, (c) the concept of cooperation with stakeholders on RMIS, also in the context of the European Union Raw Materials Knowledge Base (EURMKB). Outcomes of the workshop will increase (d) the support and promotion of relevant future JRC and other stakeholders' activities.

More specifically and in view of the above ambitions, this Workshop is targeting at:

- Surveying stakeholders' information, expectations, knowledge needs and priorities for RMKB and RMIS functions and expected JRC added value services;
- Mapping existing data, information and knowledge gaps along the supply chain with ambition of combining primary and secondary raw material streams, and with a reinforced focus on trade;
- Discussing potential ways of EU level and international co-operation for efficient networking among major actors in raw materials knowledge services and utilization;
- Outlining formal ways of establishing a platform of stakeholders; and
- Highlighting short-, and mid-term innovation ideas for related research needs in a broader context, such as European Innovation Partnership (EIP) and beyond.

The Workshop is the first step for the establishment of a long-term raw materials knowledge partnerships in line with the above objectives. Establishing efficient and fruitful partnerships is seen as essential for ongoing and future RMIS development and updates.

Annex 6 provides a summary of the workshop aim, structure and outcomes.

4.3 Key thematic milestones

A number of key thematic milestones (linking to the tiles included in the RMIS main menu) have been achieved in the course of 2017, others are foreseen to be developed in the course of 2018. These include:

- Material System Analysis
- Critical Raw Materials
- Secondary raw materials and the Circular Economy
- Raw materials' potential and trade patterns
- The 2018 EC Raw Materials' Scoreboard

- Social and environmental sustainability
- Country profiles
- Biotic raw materials

The overview of the thematic milestones provided hereafter also reflects the deliverables included in the Administrative Arrangement (AA) n. S12.719208 "*RM-EIP – Support for the implementation of the monitoring and evaluation scheme of the RM-EIP and the RMIS*" between DG JRC and DG GROWTH, signed in October 2016.

These milestones, as well as the foreseen development timelines, should not be intended as binding, but rather as a photograph of the envisaged way forward, which may change in the future.

4.3.1 Materials System Analysis

The MSA study provides data on material stocks and flows for a selection of 28 key raw materials used in the EU-28, some of them considered as critical for the EU economy. The MSA data, Sankey visualizations, and reports will be available in the RMIS 2.0 under the "Supply Chains (including stocks & flows)" module.

During 2017/2018 three new materials (e.g., Al, Cu, Fe) will be added to the RMIS MFA database. Furthermore, country-level MFA data, e.g., from economy-wide MFA accounts are currently being integrated into the RMIS MFA module. Finally, because of its system-wide perspective on raw materials issues (encompassing all life-cycle stages of a raw material), the MSA provides an overarching data structure that could be based inside the RMIS database core to collect, store, and provide data for policy knowledge needs (i.e. Raw Material System Analysis (MSA), EU Critical Raw Materials (CRM) assessment, Trade module, and Raw Materials Scoreboard). Flows/stocks parameters of the MSA can also be important to satisfy knowledge needs that may arise as a result of future policy needs, e.g., through circular economy monitoring, resilience, and other emerging issues.

Equally, complete MSAs can help in the quality assurance of the underlying mass balance/data and increasing harmonization of the various data sources – which cannot be guaranteed if only a partial picture exists. Because of this, the JRC is also currently investigating the possibilities for better integration between the MSA with other policy-related outputs and possible creation of a unique database structure within the RMIS.

Q3 of 2017: recommendations for MSA update and maintenance (completed July 2017)

Q4 of 2017: MSA analysis of at least three bulk materials

Q1/Q2 of 2018: Integration of new materials into RMIS, development of the RMIS' MSA database an integration across policy-specific sources of MSA partial info.

4.3.2 Critical Raw Materials

Q4 of 2017: Transferring the qualitative and quantitative information of the CRM fact sheets that were prepared within the framework of the study: "*Review of the list of Critical Raw Materials for the EU (2017)*" into the RMIS. This information shall be made available to relevant data users in a structured and user-friendly system. The fact sheets have been finalised, after extensive consultation with experts and stakeholders, in June 2017.

4.3.3 Secondary raw materials and the Circular Economy

The "Secondary raw materials and the Circular Economy" tile focuses on the role and importance of SRMs and other circular economy activities for the sustainable supply of raw materials for the EU economy.

The objective is to provide knowledge on SRM, which can be then used for example to monitor the effective progress towards a circular economy as well as to support specific policy dossier needs such as for the criticality assessment and scoreboard. This knowledge will be provided by means of:

- Data sources, tools, indicators and assessment methods, in order to have a set of reliable indicators available;
- Priority areas identified in the CE Action Plan, in terms of specificity, supply risks and environmental footprint of materials;
- Specific industry sectors, in order to contextualize SRM flows depending on the technological processes used for their recovery, as they are often tailored on the specific product categories to be treated.

Q4 of 2017:

Relevant data sources concerning statistics and EU-funded projects on recycling, material efficiency and SRMs will be mapped:

- Eurostat data sets;
- H2020 projects.

Relevant information concerning flows and knowledge of SRMs will be grouped:

- Information about resource efficiency and recyclability of CRMs (information about recycling rates, recycling processes, recycling potential and substitution indexes);
- Information about functional recycling of CRM within Europe (flows).

Q1 of 2018: based on the research conducted in previous JRC projects, specific information on SRMs and recyclability in the electric and electronic industry sector will be provided. Product categories will be:

- Servers
- Desktop computers
- Notebook computers / Tablet computers

Information consists of identification of bill of materials and relevant CRM content, description of the recycling processes, potential recovery of SRMs.

Q2 of 2018: based on the research conducted in previous JRC projects, specific information on SRMs and recyclability in the electric and electronic industry sector will be provided to complement the list of product groups. Product categories will include:

- Washing machines
- Dishwashers
- Vacuum cleaners
- LCD monitors

Q4 of 2018:

- Data and specific information concerning SRMs and circularity of other priority areas (construction and demolition) and industry sectors (mobility) will be implemented;
- If feasible, further linkage with other relevant H2020 projects platforms.

4.3.4 Trade and economics of raw materials

Q1 of 2017. Submission first draft of data mapping according to the envisaged data needs. To this purpose, the best worldwide official data sources have been mapped and grouped by theme (e.g., trade, production, FDI).

Data mapping was accompanied by an analysis of which data sources best fit our purposes has been, giving preference to the internationally well-established official statistics. A list of best data sets to be used and of indicators to be computed has been compiled, by topic.

Q2-Q3 of 2017. The tentative content of each thematic subsection is detailed, as summarized below.

i) The database of non-food, non-fuel raw materials has been developed. Also, the structure of *Raw materials trade flows* is elaborated, as follows:

Imports

> Country's top 20 RM product groups imported from the rest of the world in 2014, containing product-level data on:

- monetary value

- physical quantity data;

- share of total RM imports;

- share of total products imported;

> Country's top 10 RM-related import sources;

> Country's tariff profile (to be developed from Q4 of 2017 onwards).

Exports

> Country's top 20 RM product groups exported to the rest of the world in 2014, containing product-level data on:

- monetary value

- physical quantity data;

- share of total RM exports;

- share of total products exported;

> Country's top 10 RM-related export partners;

> Country's restrictions on raw materials exports in place in 2014, by type and number of HS 6-digit products;

Datasets: Database on imports and exports of non-energy and non-food commodities (raw materials plus intermediates), extracted from UN Comtrade. OECD Inventory of Restrictions on Exports of Industrial Raw Materials.

Q3-Q4 of 2017 (and onwards).

i) *Country's trade agreements*

> Country's participation in regional and partial trade agreements (to be developed from Q4 of 2017 onwards)

ii) For *production* (to be developed in starting with Q4 of 2017): there will be provided country- and product-level data on: top country producers in 2014 (physical and monetary value, where available); country' share in world production. Preliminary datasets: USGS, BGS, World mining data, Eurostat and UNSD's Industrial Commodity Statistics Database.

iii) *Foreign Direct Investment* (FDI) subsection will be devoted to building country's FDI profile (i.e., inward and outward flows; stocks). Preliminary datasets: International Trade Centre (ITC), Foreign Direct Investment Statistics 2001-2013; OECD, FDI Statistics; Eurostat, European Union direct investments.

iv) Once the database will have been completed, country and product-level *trade performance & competitiveness indicators* will be developed (from O4 of 2017 onwards).

Annex 7 provides more detailed information of foreseen RMIS developments related to raw materials' economics and trade.

4.3.5 The 2018 Raw Materials Scoreboard

Q2/Q3 2018: Integration of the content of the 2018 Raw Materials Scoreboard in the RMIS. As mentioned above, the data presented in the Scoreboard will be permanent elements of RMIS on a long-term perspective. Therefore, the 2018 Scoreboard will be also incorporated to the RMIS. It is currently being developed with the support of DG JRC and it is expected to be published within the first half of 2018. The eventual publication of the 2018 Scoreboard will determine the expected implementation of its content within RMIS. Towards its final launch, the following steps are foreseen (some of them already implemented):

- Analysis of possible improvements (November 2016);
- Consultation of possible improvements to the AHWG (December 2016);
- Draft indicator fiches (June/October 2017);
- Consultation of draft indicator fiches to the Sherpas group (September, to be confirmed, 2017);
- Revised indicator fiches (November 2017);
- Consultation Sherpa group of draft final Scoreboard (end 2017);
- Scoreboard ready to be sent to the Publications Office (early 2018).

4.3.6 Environmental sustainability

Q1 and Q2 2017: Definition of the scope of the environmental sustainability content and mapping of data available on environmental pressures of the primary raw materials sector by country. Relevant data sources were identified, data were compiled and analysed covering: emissions of greenhouse gases and air pollutants, water use from official statistics, pollutant releases by the main EU industrial facilities, water stressed areas and production risks associated to limited water availability conditions. This data identification included regular contacts with the Water Unit and Air and Climate Unit of DG JRC, and many external experts. Thematic pages on environmental sustainability, with define the data scope and framework conditions were also drafted.

Q4 2017: Draft on environmental sustainability data content, including the setting of this specific knowledge framework (main regulation, industrial practices, natural framework conditions) and, at least, data on air emissions and water use.

Q3 of 2017: Development of a template example for an application showing the link between the Sustainable Development Goals and the raw materials industry sectors.

Q1 of 2018: Finalization of the application on Sustainable Development Goals.

4.3.7 Biotic raw materials

Biotic raw materials are "materials which are derived from renewable biological resources", meaning that these materials are of "biological origin excluding material embedded in geological formations and/or fossilized".

In the context of the raw materials initiative the focus is given to "materials used by the European industry except materials from agricultural production and materials used as fuel." This includes materials such as industrial roundwood, cork, natural rubber, natural fibers, medicinal plants and algae used in pharmaceutics and cosmetics.

The information on biotic raw materials in the RMIS is focused on data necessary to perform MSAs and criticality assessment of biotic raw materials, which includes data on: biotic resources locations and stocks, production, foreign trade, uses, collection and recycling, waste streams and losses and sustainability of supply. The next septs to be developed in the course of 2017 and 2018 include:

Q4 2017 Transferring the qualitative and quantitative information of the biotic raw materials fact sheets that were prepared within the framework of the study: "Review of the list of Critical Raw Materials for the EU (2017)" into the RMIS. This includes information on cork, natural rubber, teak wood and sapele wood.

Q2 2018 establish the link between RMIS and external data providers on biotic raw materials. To complement the tile on raw material knowledge gateway. An important example to complement the knowledge on biotic raw materials is the Bioeconomy Observatory (developed by JRC) which brings together data and information about bioeconomy, including data on biotic raw materials. The Observatory will be followed-up by a Bioeconomy Knowledge Centre in 2017/2018.

Q3 2018 Review and data collection of data necessary to perform MSA of a biotic raw material e.g. Natural Rubber.

4.4 Concluding remarks

Following the official launch of RMIS 1.0 in 2015, year 2016 and the first half of 2017 were primarily devoted to the preparations of the new website design, the underlying new structure, an updated and significantly extended content, the most recent version of which is presented in this report. During this period, new requests were formulated in relation to internal EC policy support. For example, this drove certain development directions such as the migration of the MSA application and the Minventory content from DG GROW to the RMIS.

Lots of efforts were made on establishing the stakeholders network, externally and also within the JRC capacities, i.e. with other Units and Directorates, such as at the Workshop on raw materials supply (January 12th, 2017) and especially the 1st International workshop on the EC Raw Materials Information System (March 2017). Future workshops of are foreseen to further expand and strengthen the ties within the raw materials community of the JRC; building focused Networks.

Beyond supporting the future progress of the information system, as well, the development team has to comply with new challenges, such as the growing interest in responding to information needs on trade figures on volumes, capacities and the different legal and administrative barriers of this crucial overarching field.

The last quarter of 2017 is expected to see official inauguration of RMIS 2.0, which will be an essential step forward to a true gateway information source on raw materials of the European Union. However, the full coverage of materials and countries, and their thematic factsheets, as well as numerous downstream chapters, are not expected to be developed at this stage.

References

DG for Internal Market, Industry, Entrepreneurship and SMEs, 2015: KBA - European Raw Material Knowledge Base Architecture, Final Report, Brussels, 322 p.

European Commission, 2008, Communication from the Commission to the European Parliament and the Council: The raw materials initiative – meeting our critical needs for growth and jobs in Europe, COM(2008) 699 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0699:FIN:en:PDF)

European Commission, 2011, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Roadmap to a Resource Efficient Europe, COM(2011) 0571 final (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2011:0571:FIN)

European Commission, 2013, 'The Strategic Implementation Plan (SIP); EIP's action plan' (https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/strategic-implementation-plan-sip-0)

European Commission, 2013, 'The Strategic Implementation Plan (SIP) for the European Innovation Partnership (EIP) on Raw Material Action area no. II.8 of the 2013' (https://ec.europa.eu/programmes/horizon2020/en/area/raw-materials)

European Commission, 2014, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – for a European Industrial Renaissance, COM(2014) 14 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2014:0014:FIN:EN:PDF)

European Commission, 2014, Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions – Towards a Circular Economy: A zero Waste Programme for Europe COM(2015) 614 final (http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52014DC0398)

European Commission, 2014, Raw Material System Analysis (https://ec.europa.eu/jrc/en/scientific-tool/msa)

European Commission, 2015, 'Critical Raw Materials' (https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en)

European Commission, 2015, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Closing the loop - An EU action plan for the Circular Economy, COM(2015)614 final (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614)

European Commission, 2015, Material System Analysis study – 'Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials' (https://ec.europa.eu/assets/jrc/msa/images/msa_final_report.pdf)

European Commission, 2015, Minventory: EU raw materials statistics on resources and reserves study' (https://ec.europa.eu/docsroom/documents/10224/attachments/1/translations/en/renditions/pdf)

European Commission, 2015, The EU Resource Efficiency Scoreboard 2015, (http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/pdf/EU%20Resource%20Efficiency%20Scoreboard%202015.pdf)

European Commission, 2016, 'Horizon 2020, The EU Framework Programme for Research and Innovation: Raw materials' (https://ec.europa.eu/programmes/horizon2020/en/area/raw-materials)

European Commission, 2016, Minventory, (https://ec.europa.eu/jrc/en/scientific-tool/minventory)

European Commission, 2016, Raw Materials Information System – Scoreboard, (http://rmis.jrc.ec.europa.eu/Scoreboard/)

European Commission, 2016, 'Raw Materials Scoreboard' (http://bookshop.europa.eu/en/raw-materials-scoreboard-pbET0215541/)

European Commission, 2017, 'European Raw Materials Knowledge Base (EURMKB)' (http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/knowledge-base/index_en.htm)

European Commission, 2017, 'Industries related to raw materials' (https://ec.europa.eu/growth/sectors/raw-materials/industries_en)

The Administrative Arrangement (AA) n. S12.719208 "RM-EIP – Support for the implementation of the monitoring and evaluation scheme of the RM-EIP and the RMIS" between DG JRC and DG GROWTH, signed in October 2016.

List of abbreviations

CE	Circular Economy
CRM	Critical Raw Materials
EC	European Commission
EU	European Union
EIP-RM	European Innovation Partnership on Raw Materials
EURMKB	European Raw Materials Knowledge Base
LCA	Life Cycle Assessment
MFA	Material Flow Analysis
MSA	Material System Analysis
RMI	Raw Materials Initiative
RMIS	Raw Materials Information System
SIP	Strategic implementation Plan (of the EIP-SIP)

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Annex 1: RMIS 1.0: content overview

The current version of the RMIS has been launched in March 2015. Its structure was predominantly maintained since then. Hereinafter, it is referred to as RMIS 1.0. The following bullets provide a brief overview of the content of the RMIS 1.0 website as of January 2016, following the items of the main horizontal menu-items (Figure 7).

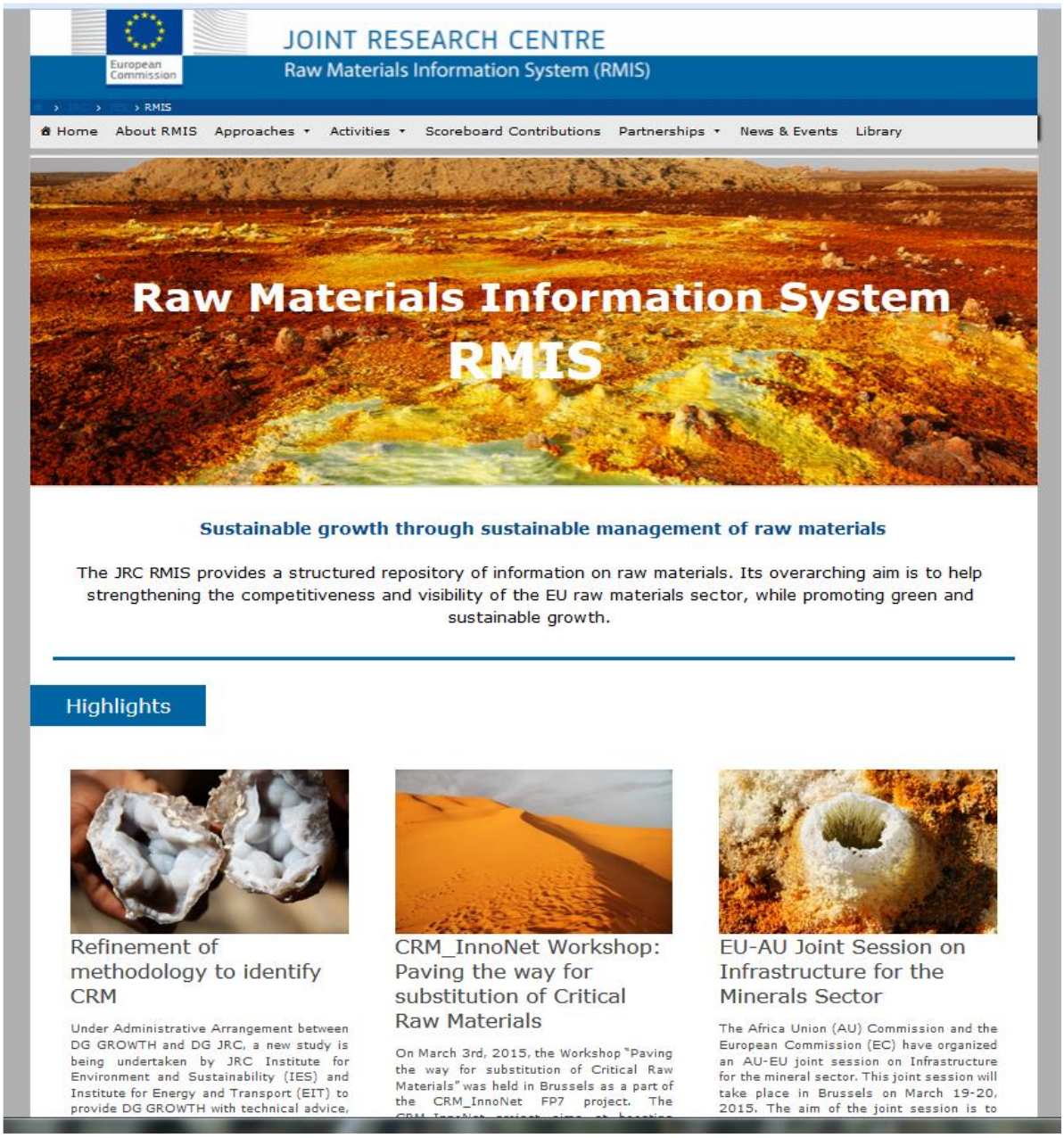


Figure 7: Home page of RMIS 1.0, as of January 2016.

The "**Home**" section is the "welcome page" of the RMIS 1.0 and also provides links to the most recent highlights.

The "**About RMIS**" section contains an introduction to the raw materials' context and explains the overall scope of the RMIS. It also provides a brief overview of the policy drivers behind the RMIS, the identified knowledge needs and knowledge providers.

The "**Approaches**" section contains an overview of selected conceptual approaches that are available for analysing or evaluating, specific aspects related to raw materials or along the raw materials' supply chain. This includes concepts like "criticality of raw materials" and "material efficiency".

The "**Criticality of raw materials (RMs)**" section presents the topic of raw materials' criticality in Europe. It explains the reasoning behind the policy concerns on critical raw materials, a brief introduction of the methodology that leads to the identification of the list critical raw materials, and some references to more detailed information about the issue. The criticality of RM is related to the security of raw material supply.

The "**Material Efficiency**" section provides specific information concerning material efficiency of products in the EU, starting from the policy drivers, the explanation of the REAPro methodology to measure material efficiency of products (developed by the JRC), and the achievement and prospects of using this methodology. Further, also information on resource efficiency is provided, i.e. the efficiency of using the resources extracted. The section also contains a comprehensive list of references concerning material efficiency.

The "**Activities**" section provides information on a number of selected activities relevant in the context of the RMIS and the European raw materials sector. Each of these activities is presented in terms of the context, approach, and the expected output.

The "**Scoreboard contributions**" section intended to provide an overview of the content 2016 Raw materials Scoreboard. However, since the Scoreboard was released during Q3 of 206, this section was not finalised as of January 2016.

The "**Partnerships**" section is aimed at presenting the raw materials knowledge network being established for the development of the RMIS. This includes policy DGs, the Joint Research Centre (JRC), business associations, academia, project consortia (such as of FP7 and H2020 projects). In particular, networks established by raw material related FP7 projects shall be integrated into the knowledge network, like from Minerals4EU, ProSUM, etc., thus providing thematic clusters of network participants.

The "**Library**" section is an archive containing key references that are relevant in the context of the RMIS. These references are divided into the sub-groups: Legislation, reports and guidelines, scientific papers, and news and events.

Annex 2: A review of potential knowledge providers and data sources

Potential knowledge providers: European Commission

Table 1: Knowledge providers for RMIS 2.0 – European Commission and European Union institutions

The European Innovation Partnership (EIP) on Raw Materials	Timing
	2013-2020
	Scope and Objective
	• The European Innovation Partnership on Raw Materials is a stakeholder platform that brings together representatives from industry, public services, academia and NGOs. • The mission of EIP on Raw Materials is to provide high-level guidance to the European Commission, Members States and private actors on innovative approaches to the challenges related to raw materials. • The overall objective of the EIP on Raw Materials is to contribute to the 2020 objectives of the EU's Industrial Policy by ensuring the sustainable supply of raw materials to the European economy whilst increasing benefits for society as a whole. • The EIP's action plan, Strategic Implementation Plan (SIP) incorporates inputs from EU governments, industry, academia and NGOs, consulted at meetings of the EIP's Operational Groups. The SIP is structured into 7 priority areas and 24 action areas. • The EIP also conducts Monitoring and Evaluation scheme tracks progress at four different levels: the EIP's Raw Materials Commitments, action areas, targets and objectives.
	Relevant knowledge for RMIS development
	• Comprehensive raw-materials-related topics; Research and innovation coordination, technologies for primary and secondary RM production, substitution of raw materials, raw materials framework conditions, Europe's waste management framework conditions and excellence, knowledge, skills and raw materials flows, and international cooperation • The knowledge base structure for raw materials information system, as reported in the Knowledge Base Architecture (KBA), a support activity under the European Raw Materials Knowledge Base (EURMKB). The EURMKB is a part of the SIP aimed at providing EU level data and information on raw materials from different

	sources in a harmonized and standardized way. • EIP's monitoring and evaluation: Annual Monitoring Report, SIP Implementation Document, Strategic Evaluation Report, and Raw Materials Scoreboard
	Timing
	2014-2015
	Scope and Objective
	• DG GROW has carried out the Material System Analysis (MSA) study with expert consultation as the follow-up of the Study on Data Needs for a Full Raw Materials Flow Analysis launched by the European Commission in 2012 within the context of the European Raw Materials Initiative's strategy. • The objective of MSA study is to provide information on non-energy material flows and to assist the European Commission on the development of a full Material System Analysis (MSA) for a selection of key raw materials in the European Union.
	Relevant knowledge for RMIS development
	A map of the flows of materials through the economy in terms of entry into the economy, and movement through the economy with additional information related to security of supply, substitutes, future supply, and demand changes of 28 raw materials of which some are considered as critical for Europe.
	Timing
	1961 – (...)
	Scope and Objective
	• The JRC is the European Commission's science and knowledge service • The Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle. • The JRC activities are clustered into ten sciences areas
	Relevant knowledge for RMIS development
	• Publications (e.g. Critical Raw Materials for Energy Technologies), scientific tools and database (e.g. The

	European Platform of Life Cycle Assessment-EPLCA), reference and measurement documents (e.g BREFs), patent and technologies related to both biotic and abiotic raw materials in various science areas
	Timing
	1953-(...)
	Scope and Objective
	• Eurostat is the statistical office of the European Union whose task is to provide the European Union with statistics at European level that enable comparisons between countries and regions. • Based on harmonized concepts, methodologies and standards, Eurostat provides consolidated and comparable country-level and regional data on a multitude of themes, such as demography, economy, agriculture, industry, trade, social conditions, transport, environment and science and technology.
	Relevant knowledge for RMIS development
	• Economy-wide material flow accounts (EW-MFA) provides aggregate data on the inflows, outflows and consumption of non-biotic and biotic materials in the EU; • PRODCOM dataset provides product-level data on the production of goods by manufacturing industry, ensuring correspondence with the Statistical classification of economic activities in the European Community (NACE) and Combined Nomenclature (CN) used for tracking trade exchangers of goods; • Structural business statistics (SBS) database collects and presents enterprise-based information on EU business structure, activities and performance in industry, construction, trade and services. • Comext database provided information value and quantity of goods traded between the EU countries (i.e., intra-EU trade) and between the EU countries and non-EU countries (i.e., extra-EU trade); various international trade indicators (e.g., trade concentration, export intensity); by commodity, activity, partner country etc. • Environmental Data Centre on Waste offers data and indicators on generation, management and export of waste, useful in collecting relevant data on secondary raw materials.
	Timing
	1990-(…)
	Scope and Objective

	The European Environment Agency (EEA) is an agency of the European Union, which provides information on the environment.
	Relevant knowledge for RMIS development
	Environmental related information aggregated by sector, including mining and industrial activities.
	Timing
	1994-(…)
	Scope and Objective
	EU-OSHA is the European Union information agency for occupational safety and health (OSH)
	Relevant knowledge for RMIS development
	Occupational safety and health related information linked to social aspect of raw materials activities in the supply chain.
	Timing
	2007-(…)
	Scope and Objective
	• The European Chemicals Agency issued a regulation on Registration, Evaluation, Authorisation, and Restriction on Chemicals (REACH) REACH aims to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances. The regulation was put into force in the EU in 2007.
	Relevant knowledge for RMIS development
	Chemicals are used in the provision of primary and secondary raw materials. In turn, the chemicals sector relies on raw material inputs to produce chemicals. REACH provides information on the risks from chemicals which can be

	related to primary/secondary raw materials production and downstream uses.
	Timing
	2009-(…)
	Scope and Objective
	• ESMA is an independent EU Authority that contributes to safeguarding the stability of the European Union's financial system by enhancing the protection of investors and promoting stable and orderly financial markets. • The mission of ESMA is to enhance investor protection and promote stable and orderly financial markets. The objectives of ESMA are investor Protection, orderly Markets and financial Stability.
	Relevant knowledge for RMIS development
	Reference for investor's corner: guidelines and technical standards for EU financial market, information regarding corporate disclosures, credit rating agencies, fund management, investor protection, benchmark, short selling, post trading in the EU.
	Timing
	2014 – (…)
	Scope and Objective
	• The Executive Agency for Small and Medium-sized Enterprises (EASME) has been set up by the European Commission to manage on its behalf several EU programmes. • The EASME is in charge of managing SME, environment, energy and maritime projects funded under COSME, Horizon 2020, LIFE and EMFF and organising the European Sustainable Energy Week (EUSEW).
	Relevant knowledge for RMIS development
	• Information dedicated to SME: funding opportunities and SME support • Links repository to practical guide on how to do business in Europe • Data hub with map on ongoing projects funded by the SME instrument

The European Institute of Innovation and Technology (EIT)	Timing
	2008-2020
	Scope and Objective
	• The European Institute of Innovation and Technology (EIT) is a unique EU initiative that spurs innovation and entrepreneurship across Europe. EIT bring together leading universities, research labs and companies to form dynamic pan-European partnerships called Knowledge and Innovation Communities (KICs). The partnerships will develop innovative products and services, start new companies, and train a new generation of entrepreneurs. • Currently there are six KICs which focus on different societal challenge, some closely related to raw materials e.g. EIT Raw Materials (addressing sustainable exploration, extraction, processing, recycling and substitution), EIT-Climate-KIC (addressing climate change mitigation and adaptation), and EIT InnoEnergy (addressing sustainable energy).
	Relevant knowledge for RMIS development
	Knowledge, technologies and processes related to primary and secondary sources of critical raw materials (CRM), competitiveness (e.g. through new job creations)

Potential knowledge providers: FP7 and Horizon2020

Table 2: Knowledge providers for RMIS 2.0 – FP7 and Horizon2020

EIT Manufacturing	Timing
	2016-2020
	Scope and Objective
	• The EIT call for knowledge and innovation communities (KIC) addressing the thematic field of manufacturing

	was launched in early 2016. • The topic of the call is "added-value manufacturing"; to address the challenge in the manufacturing sector faced by European countries (i.e. increased competition, raw materials scarcity, new market and societal needs, environmental concerns) by the development of a high added value manufacturing industry-delivering product/service innovation, establishing process excellence, achieving high brand recognition and/or contributing to a sustainable society. • The focus of the KIC is the integration of all stakeholders concerned with manufacturing • The goal is to strengthen and increase the competitiveness of Europe's manufacturing industry.
	Relevant knowledge for RMIS development
	• Major economic and societal relevant challenge concerning manufacturing sector in Europe. • Research, innovation, education and training stakeholders along the value chain. • Knowledge in the following topics: Eco-design, the development of added-value products, and services, new business models and advanced manufacturing engineering processes, advanced manufacturing engineering processes.
	Timing
	2014-2020
	Scope and Objective
	• The European Innovation Partnership on Raw Materials is a stakeholder platform that brings together representatives from industry, public services, academia and NGOs from more than 20 countries. • The mission of EIT Raw Materials is to boost competitiveness, growth and attractiveness of the European raw materials sector via radical innovation and guided entrepreneurship. • The strategic objectives of the EIT Raw Materials are (1) securing raw materials supply, (2) designing solutions across the whole life cycle of raw materials, (3) closing material loops. • The scope of the EIT Raw Materials is metal and mineral raw materials.
	Relevant knowledge for RMIS development
	• Update of innovation in technologies and processes in raw material sector, both primary and secondary, for example knowledge, skills, and technology for the design of new sustainable products and services. • An integrated knowledge base on sustainable materials management and the state-of-the-art information on sustainable extraction and conversion of raw materials from EIT Raw Materials and Sustainability Support and

	Information Centre (SSIC)
	Timing
	2013-2015
	Scope and Objective
	• The Minerals4Eu project was born to fulfil the need to provide an EU Mineral Intelligence network structure to deliver data, information and knowledge on mineral resources around Europe. • The project is expected to give a contribution to the European Innovation Partnership on Raw Materials (EIP RM), seen by the Competitiveness Council as key for the successful implementation of the major EU2020 policies.
	Relevant knowledge for RMIS development
	Web portal, a European Minerals Yearbook and prospective studies.
	Timing
	2015-2018
	Scope and Objective
	• Mineral Intelligence Capacity Analysis (MICA) is an EU-Horizon 2020 research and innovation program-funded project that lies within the context of establishing raw materials knowledge infrastructure at EU level. • The objective of MICA is to provide possible information on raw materials in a web-based platform, the European Union Raw Materials Intelligence Capacity Platform (EU-RMICP).
	Relevant knowledge for RMIS development
	A knowledge platform that answers to some questions/problems posed by stakeholders related to raw materials in a specific context, for example policy, economics, primary production, recycling, wastes.
	Timing

	2015-2017
	Scope and Objective
	PROSUM is an EU-funded project which intends supply the inventory component of the EU-level knowledge base related to secondary raw materials which is currently missing.
	Relevant knowledge for RMIS development
	A centralized database of information on waste electrical and electronic equipment (WEEE), end-of-life vehicles (ELVs), batteries, and mining wastes and a user friendly web portal.
	Timing
	2013-2018
	Scope and Objective
	• ERECON project was established in the view of securing Rare Earth Element supply. The work of ERECON project focuses on opportunities for primary supply of rare earths in Europe, resource efficiency and recycling, end-user industries, trends and challenges in rare earths supply. • The project was established in 2013 and it involves more than 80 European rare earths experts from industry, academia, and the policy world.
	Relevant knowledge for RMIS development
	• Knowledge related to Rare Earth supply in Europe, for example challenges in supply and the potential strategy to overcome them through research, policy, industries, and international cooperation. • Rare Earth supply chain: supply, re-use and re-cycling, policy options to improve EU rare earths supply security.
	Timing
	2012-2015
	Scope and Objective

	• CRM_InnoNet is a project funded by the European Commission to drive progress in the field of substitution of critical raw materials. • The activities of the project comprise mapping of the sectors of application that need to be given priority for substitution, defining strategy and roadmap for CRM substitution based on the priority area, engaging stakeholders involved in substitution activity and finally to give policy recommendation.
	Relevant knowledge for RMIS development
	Substitutability of CRM
	Timing
	2011-2015
	Scope and Objective
	• ERAMIN2 is the continuation of ERAMIN, a network of European organizations owning and/or managing research programs focusing on the non-energy mineral resources: construction minerals, industrial minerals and metallic minerals. • The aim of ERAMIN2 is to promote coordinated research on the entire raw materials value chain. In order to reach this goal, the main tasks of this network have been defined: mapping and networking the European non-energy mineral raw materials research community, road mapping research priorities, and implementing joint actions.
	Relevant knowledge for RMIS development
	Overview of the existing European initiatives and research programs in non-energy mineral resources, research priorities in the sector.
	Timing
	2015-2017
	Scope and Objective
	SMART GROUND project was established to improve the availability and accessibility of data and information on

	secondary raw materials (SRM) and create synergies among the different stakeholders involved in the SRM value chain: End-users, RTD institutions, and Technology Transfer Providers. The data and information will be collected from new and existing sources.
	Relevant knowledge for RMIS development
	• Database and related information to SRM • Knowledge transfer and implementation activities
	Timing
	2016-2019
	Scope and Objective
	• The SCRREEN project was born as a response to the importance of critical raw materials (CRM) which requires a comprehensive knowledge from associated stakeholders. • The objective of SCRREEN is to establish an expert network to address the issues related to critical raw materials in relation with different aspects such as policy, technology, standards, and markets.
	Relevant knowledge for RMIS development
	Knowledge on supply of CRM both from primary and secondary sources, foresight of the current and future use of CRM, production, substitution, technology gap, WEEE issues, and policy issues related to CRM.
	Timing
	2015-2018
	Scope and Objective
	• The INTRAW project is connected to the European Union's growth strategy "Europe 2020" of Industrial Policy for the Globalization Era and Resource-efficient Europe. • The objective of INTRAW is to map best practices and develop cooperation opportunities on raw materials between the EU and the technologically advanced non-EU countries (such as Australia, Canada, Japan, South Africa, and the United States), addressing on research and innovation, policies and strategies, education,

	licensing and permitting, data reporting system, mining practices, management and substitution of Critical Raw Materials.
	Relevant knowledge for RMIS development
	• Information regarding cooperation opportunities between the EU/individual EU member state and international cooperation countries, international cooperation on raw materials • Information regarding grants and research cooperation activities as well as R&I activities between the EU, individual EU member and technologically advanced countries.
	Timing
	2014-2020
	Scope and Objective
	• NEW-MINE is a consortium of high profile universities, research institutions and companies located in Belgium, Germany, Austria, Switzerland, Sweden, Italy and UK. • NEW-MINE trains early-stage researchers (ESRs) in all aspects of landfill mining, in terms of both technological innovation and multi-criteria assessment with the objective to obtain highly sought-after scientists and engineers for the rapidly emerging landfill-mining and broader raw-materials industries of Europe.
	Relevant knowledge for RMIS development
	Mining waste, landfill mining
	Timing
	2015-2018
	Scope and Objective
	• MINATURA2020 is driven by the need to provide a policy-planning framework that comprises the "sustainability principle" for mining like for other land uses. • The objective of MINATURA2020 is to develop a concept and methodology for the definition and subsequent protection of "mineral deposits of public importance" in order to ensure their «best use» in the future in order to be included in a harmonized European regulatory/guidance/policy framework.

	Relevant knowledge for RMIS development
	Land use in mining activity, information on future potential mineral deposits
	Timing
	2016-2018
	Scope and Objective
	• In the context of supporting the secure and sustainable supply of minerals in Europe, the MIN-GUIDE project focuses on developing minerals policy guide. • The objectives of the project are to provide guidance for EU and MS minerals policy, facilitate minerals policy decision making through knowledge co-production for transferability of best practice minerals policy, and to promote foster community and network building for the co-management of an innovation catalysing minerals policy framework.
	Relevant knowledge for RMIS development
	The expected outcome, 'Mineral Policy Guide' will provide knowledge of best practice of mineral policy along the whole mineral production value chain (exploration and extraction, processing, recycling and mine closure).
	Timing
	2015-2018
	Scope and Objective
	• VERAM project was born to answer the need for coordination of Research and Innovation activities in raw material sector in the EU. • The objectives of VERAM project in the area of raw materials R&I are to facilitate information exchange, produce 2030 medium term vision and 2050 long term strategic research and innovation roadmap, and support innovation by speeding up and facilitating industrial exploitation of research results.
	Relevant knowledge for RMIS development

	Information regarding future research agenda in raw materials sector
	Timing
	2016-2019
	Scope and Objective
	• CHPM2030 is a Horizon2020 project under that focuses on technology. • The project aims to develop a facility that manipulates the metal-bearing geological formation to enables the co-production of energy and metals.
	Relevant knowledge for RMIS development
	Knowledge on technology, focusing on metal extraction with co-production of energy
	Timing
	2016-2019
	Scope and Objective
	• INTMET is an ongoing project under Horizon2020 in Research and Innovation action in technological field. • The project aims to increase metal recovery rate through chemical processes.
	Relevant knowledge for RMIS development
	Knowledge on technological development in recovery of valuable metals (Cu, Zn, Pb, Ag) and CRM (Co, In, Sb)
	Timing
	2016-2020
	Scope and Objective

in Europe)	• The MIN-GUIDE project aims to enhance a secure and sustainable supply of minerals in Europe by fostering an innovation friendly minerals policy framework. • The project will develop a Minerals Policy Guide that serves as a comprehensive and user-friendly guide to minerals policy and legislation at EU and national level.
	Relevant knowledge for RMIS development
	Mineral policy (national and EU level)
	Timing
	2015-2017
	Scope and Objective
	The project's call aims to promote the activity of European companies active in the mining and raw materials sectors in non-EU countries, inward mining investment to the EU and cooperation with raw materials producing countries, including exchange of best practices in raw materials policy, stakeholder dialogues, and social license to operate, resulting in strong and sustainable relationships with these countries.
	Relevant knowledge for RMIS development
	• Newsletter about European raw material project-related topics and research • Policy briefs, presentations and reports on European raw material supply
	Timing
	A call for 2017 has been launched in November 2016
	Scope and Objective
	A H2020 call was launched under the Raw materials policy support actions to answer to the challenges faced by the EU knowledge base on primary and secondary mineral raw materials such as is the quality, harmonization of the collected data and information sharing at the different levels within the EU by optimizing collection of data in Member States

	Relevant knowledge for RMIS development
	• Better quality Raw materials data from member states are to be expected as a future output of this call.

Table 3: Additional potential knowledge provider

Knowledge provider	**Website**
AgrAl Project (Advanced Green Aluminum Anodes)	https://www.agral-project.com/
BIOMORE, an alternative mining concept	https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/content/biomore-alternative-mining-concept-raw-materials-commitment
Blue Nodules	http://www.blue-nodules.eu/
CHROMIC	http://www.chromic.eu/
CloseWEEE	http://closeweee.eu/
Equinox	http://equinox-project.eu/
FAME – Flexible and Mobile Economic Processing Technologies	www.fame-project.info
Flinstone2020	http://flintstone2020.eu/
FORAM (Towards a World Forum on Raw Materials)	http://www.foramproject.net/
HARFIR (Heusler Alloy Replacement for Iridium)	http://www.harfir.eu/
HISER (Holistic Innovative Solutions for an Efficient Recycling and Recovery of Valuable	http://www.hiserproject.eu/

Raw Materials from Complex Construction and Demolition Waste)	
HiTech AlkCarb	https://www.bgs.ac.uk/HiTechAlkCarb/
IMPACTPapeRec	http://impactpaperec.eu/en/home/
INFINITY -Indium-free innovative Technology	https://infinity-h2020.eu/
INREP (Towards Indicum free TCOs)	http://www.inrep.eu/
Iterams (Integrated mineral technologies for more sustainable raw material supply)	http://cordis.europa.eu/project/rcn/210182_en.html
LIFE Recumetal project (Design and development of a demonstrative pilot plant to recycle indium and yttrium from discarded flat panels)	http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5221
LoCO2Fe (Development of a Low CO2 Iron and Steelmaking Integrated Process Route for a Sustainable European Steel Industry)	http://cordis.europa.eu/project/rcn/194922_en.html
METGROW+	http://metgrowplus.eu/
MinFuture (Global material flows and demand-supply forecasting for mineral strategies)	http://www.minfuture.eu
MINLEX - Study- Legal framework for mineral extraction and permitting	http://www.minlex.eu/

procedures for exploration and exploitation in the EU	
MSP-REFRAM Multi-Stakeholder Platform for a Secure Supply of Refractory Metals	http://prometia.eu/msp-refram/
NOVAMAG (Novel, Critical Materials Free, High Anisotropy Phases for Permanent Magnets, by Design)	http://www.novamag.eu/
OptimOre Project	https://optim-ore.eu/
Platirus (PLATInum group metals Recovery Using Secondary raw materials)	http://www.platirus.eu/
Robotic subsea exploration technologies	
SILC II (The Sustainable Industry Low Carbon II)	https://ec.europa.eu/easme/en/horizon-2020-silc-ii
SIMS (sustainable Intelligent Mining Systems)	http://www.simsmining.eu
SLIM	http://cordis.europa.eu/project/rcn/206220_en.html
Solsa (An Innovative Project for Sustainable Exploration Technologies and Geomodels)	http://www.solsa-mining.eu/
Uinexmin (Underwater explorer for flooded mines)	http://www.unexmin.eu/
VAMOS (Viable Alternative Mine Operating System)	http://vamos-project.eu/

X-Mine (Real-Time Mineral X-Ray Analysis for Efficient and Sustainable. Mining)	http://cordis.europa.eu/project/rcn/210175_en.html

Potential knowledge providers: structural Development, cohesion funds and other funding

Table 4: Knowledge providers for RMIS 2.0 – Structural development and cohesion funds and other finding

SNAP-SEE (continuation of SARMA)	Timing
	2013-2015
	Scope and Objective
	The primary objective was to develop a Toolbox for Aggregates Planning to support national/regional, primary and secondary aggregates planning in Southeast Europe (SEE) countries.
	Relevant knowledge for RMIS development
	The outcome of the project is a toolbox for aggregates planning to support national and regional, primary and secondary aggregates planning in SEE countries, which include, among others: • Handbook on Capacity Building and Stakeholder Consultation; • Handbook on Data and Analysis Methods; • Aggregates Planning Scheme, containing planning modules that embody the principles, approaches and action necessary to achieve the goals of the Vision.
	Timing
	2006-2007*

Regions (ENMR)	*In frame of H2020 a call with similar content was published in 2016 to be evaluated by the second half of 2017
	Scope and Objective
	• The aim of the ENMR was to create a European partnership of authorities and stakeholder organizations from European mining regions in the form of a permanent network with the main objective to strengthen regional stakeholder partnerships within European mining regions, sharing of best practices and collaborations in mining, elevation of common interests and needs of the mining region.
	Relevant knowledge for RMIS development
	The ENMR roadmap provided recommendations and strategies to answer to mining challenges and opportunities.
	Timing
	2013-2015
	Scope and Objective
	Minventory is a portal under DG Growth that contains links to external bodies, data providers, and legislative registers, related to primary raw materials, mining waste, landfill stocks, and landfill waste flows from each state of EU28 and some neighbouring countries.
	Relevant knowledge for RMIS development
	A list of information source on the Competent Authorities responsible for collecting and publishing sets of data on primary raw materials production, mining waste, landfill stocks, and landfill waste flows distinguished by materials and country, mostly national entity.

Potential knowledge providers: multilateral Member States initiatives

Table 5: Knowledge providers for RMIS 2.0 – Multilateral Member States initiatives

NordMin	Timing
	2013-2015
	Scope and Objective
	• NordMin is a network of Expertise for a sustainable mining and mineral industry funded by the Nordic Council of Ministers, which involves the participation of Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland, and Åland. • The objective of NordMin is to increase the global competitiveness and sustainability of the mining and mineral industry in the Nordic region through cooperation within research, education and development.
	Relevant knowledge for RMIS development
	NordMin can be a point of reference for knowledge and network for a sustainable mining and mineral industry in Nordic region.

Preliminary review of potential data sources

Table 6: Review of potential data sources for RMIS 2.0

Information	**Source**	**Website**	**Details**
	USGS (Open-File Report 2010–1257) (Europe)	http://pubs.usgs.gov/of/2010/1257/	Map displays over 1,700 records of mineral facilities within the countries of Europe and western Eurasia. Each record represents one commodity and one facility type at a single geographic location. Facility types include mines, oil and gas fields, and plants, such as refineries, smelters, and mills. Common commodities of interest include aluminum, cement, coal, copper, gold, iron and steel, lead, nickel, petroleum, salt, silver, and zinc. Records include attributes, such as commodity, country, location, company name, facility type and capacity (if applicable), and latitude and longitude geographical coordinates (in both degrees-minutes-seconds and decimal degrees).

Information	Source	Website	Details
	USGS Mineral Resources On-Line Spatial Data (Global)	http://mrdata.usgs.gov/	These annual reviews are designed to provide timely statistical data on mineral commodities in various countries. Each report includes sections on government policies and programs, environmental issues, trade and production data, industry structure and ownership, commodity sector developments, infrastructure, and a summary outlook.
	EuroGeoSurveys (Europe)	http://www.eurogeosurveys.org/	Mineral occurrences, resources, reserves, production
Biotic Raw materials	(1) FAO databases	(1) http://www.fao.org/faostat/en/#home	Statistical information on production, trade, land use and sustainability.
	(3) Bioeconomy Observatory	(3) https://biobs.jrc.ec.europa.eu/	Data and information about bioeconomy, including statistics on investments in research, policy mapping, bioeconomy country profiles, data visualisation and analytical reports.
Biomass Facilities	(1) The OECD-FAO Agricultural outlook databases (2) Nova Institute reports	(1) http://www.agri-outlook.org/ (2) http://www.nova-institut.de/bio/index.php?tpl=novalist	
	USGS Mineral Resources On-Line Spatial Data (Global)	http://minerals.usgs.gov/minerals/pubs/country/	Metal and mineral commodity production by country
			Total Minerals Production, by Continents
			Total Minerals Production, by World Regions

Information	Source	Website	Details
	BGS European Mineral Statistics (EU36)	http://www.bgs.ac.uk/mineralsuk/statistics/europeanStatistics.html	Provides production data by country and exports/imports of commodities (in physical units!).
		http://minerals.usgs.gov/minerals/pubs/country/	
		http://minerals.usgs.gov/minerals/pubs/mcs/	
	Eurostat (EU-28)	http://ec.europa.eu/eurostat/web/international-trade/data/main-tables	EU28 trade by Member State, by partner, and by product group
			Total Imports
			Extra EU Imports
			Total Exports
			Extra EU Exports
			Note: Time series data from 1990-2014 for wood, timber, bulk metals (e.g., Fe, Cu, Zn), precious metals, and non-metallic minerals). Physical units.
	BGS European Mineral Statistics (EU-36)	http://www.bgs.ac.uk/mineralsuk/statistics/europeanStatistics.html	Exports/imports of commodities (in physical units) for EU36.
			Domestic Extraction

Information	Source	Website	Details
Accounts	(EU-28)	ec.europa.eu/nui/submitViewTableAction.do	Domestic Material Consumption
			Direct Material Inputs
			Note: Time series data from 1990-2014 for wood, timber, bulk metals (e.g., Fe, Cu, Zn), precious metals, and non-metallic minerals). Physical units.
	Material flows in the EU-27 economy (2005) (EU-27) Haas W., Krausmann F., Wiedenhofer D. and Heinz M., 2015,	-	'How Circular is the Global Economy?: An Assessment of Material Flows, Waste Production, and Recycling in the European Union and the World in 2005', Journal of Industrial Ecology. Material flows through the EU-27 economy in 2005. Even if the data are relatively outdated — due to technical limitations — they still provide interesting insights into the order of magnitude of materials used in the EU economy
			Domestic Extraction (DE)
			Domestic Material Consumption (DMC)
			Material Footprint (MF)
			Note: timber (industrial roundwood), metal ores (10 sub-types), non-metallic minerals (5 sub-types)); times-series data from 1970-2010
			Assesses the public regulatory framework that affects investment, i.e. how government policy affects attitudes, towards exploration investment in each mining jurisdiction, ranking jurisdictions based on survey respondents' views.
			Note: Only relevant for mining countries(focus on metals and minerals).
Human Development Index	United Nations Development	http://hdr.undp.org/en/content/human-	Composite statistic of life expectancy, education, and income per capita indicators, which are used

Information	Source	Website	Details
(HDI)	Programme (UNDP) (Global)	development-index-hdi	to rank countries into four tiers of human development.
Environmental Performance Index (EPI)	Environmental Performance Index (EPI) (Global)	http://epi.yale.edu/	EPI is a method of quantifying and numerically marking the environmental performance of a state's policies.
Global Innovation Index (GII)	INSEAD (Global)	https://www.globalinnovationindex.org/content/page/GII-Home	Provides an annual ranking of countries by their capacity for, and success in, innovation. It is published by INSEAD and the World Intellectual Property Organization, in partnership with other organisations and institutions, and is based on both subjective and objective data derived from several sources, including the International Telecommunication Union, the World Bank and the World Economic Forum.
Sectoral Perspective (Material Footprint, Energy Footprint, Water Footprint, GHG Footprint) of Mining and Energy Sector	UNEP Live Data by Country	http://uneplive.unep.org/	
Gross Domestic Product	Maddison Project database (Global)	http://www.ggdc.net/maddison/maddison-project/home.htm	
Current annual demand for raw materials for low-carbon energy technologies	2013, 'Critical Metals in the Path towards the Decarbonisation of the EU Energy Sector: Assessing Rare Metals as Supply-Chain Bottlenecks in Low-Carbon Energy Technologies. (EU-28)	_	The current demand and the projected demand for 2030 of the raw materials required in four low-carbon technologies, namely wind, solar photovoltaic (PV), electricity grid and bioenergy (biofuel). These technologies are identified as priorities in the EU's Strategic Energy Technology (SET) Plan

Information	Source	Website	Details
Projected annual demand for raw materials for low-carbon energy technologies	2013, 'Critical Metals in the Path towards the Decarbonisation of the EU Energy Sector: Assessing Rare Metals as Supply-Chain Bottlenecks in Low-Carbon Energy Technologies. (EU-28)	-	The current demand and the projected demand for 2030 of the raw materials required in four low-carbon technologies, namely wind, solar photovoltaic (PV), electricity grid and bioenergy (biofuel). These technologies are identified as priorities in the EU's Strategic Energy Technology (SET) Plan
Primary production	'Study on Critical Raw Materials at EU Level', 2013	-	The geographical concentration of supply for a selection of raw materials. It shows that a considerable amount of raw materials is produced by a rather limited number of countries. In addition, it includes an indication of the countries' level of governance, based on the Worldwide Governance Indicators (WGI)
Production by commodity, country and category	Minerals4EU project Yearbook,	http://minerals4eu.brgm-rec.fr/m4eu-yearbook/theme_selection.html.	Data on the production between 2004 and 2013 of a selection of raw materials.
Gross Domestic Product at market prices	Eurostat, National accounts (including GDP) Database	http://ec.europa.eu/eurostat/web/national-accounts/data/database	
GDP (current US$); GDP per capita, PPP (current international $)	The World Bank, World Database	http://databank.worldbank.org/data/home.aspx	
Investment Attractiveness Index	Fraser Institute Annual Survey of Mining Companies (EU 28 Members states and major mining countries)	https://www.fraserinstitute.org/resource-file?nid=9632&fid=3590	Investment Attractiveness Index for major mining countries.

Information	Source	Website	Details
Share of imports by material (import dependency)	'Critical raw materials for the EU', 2010 (EU 28)	_	A number of raw materials for which the EU is largely dependent on imports.
		http://minerals.usgs.gov/minerals/pubs/commodity/myb/	
		http://minerals.usgs.gov/minerals/pubs/mcs/	
	World Mining Data (~54 materials)	http://www.wmc.org.pl/?q=node/49	Production of Mineral Raw Materials of individual Countries, by Minerals
	EGS? (# of materials?)	http://www.eurogeosurveys.org/	
	SNL? (# of materials?)	http://www.snl.com/	
	BGS European Mineral Statistics (~71 materials in EU36)	http://www.bgs.ac.uk/mineralsuk/statistics/europeanStatistics.html	Statistical information by commodity for EU36.
	BGS (~73 materials)	http://www.bgs.ac.uk/mineralsuk/statistics/worldStatistics.html	World Mineral Statistics
	Share of world metals mining (metals)		ICMM, 2012, 'Trends in the mining and metals industry — Mining's contribution to sustainable development'.
	Eurostat, Prodcom - statistics by product Database - EU production statistics	http://ec.europa.eu/eurostat/web/prodcom/data/database	Covers commodity-level production from Mining and quarrying and Manufacturing sectors (i.e., sections B and C in NACE Rev. 2;

Information	Source	Website	Details
	by commodity		
Biomass Production	The JRC Forest Database	http://forest.jrc.ec.europa.eu/	
Felling rates (% net forest increment) by country	Forest Europe, 2015, 'State of Europe's forests 2015'.		An overview of the proportion of wood cut down in Member States' forests — felling rates — as a percentage of the net yearly wood growth of the forest (net annual increment).
Reserves/Reserve Base	USGS Commodity Summaries (90 materials)	http://minerals.usgs.gov/minerals/pubs/mcs/	Reserve base estimates end in 2009.
Metallic mineral exploration projects per development stage	SNL Metals & Mining, exploration budget survey.	http://www.snl.com/	Metallic mineral exploration activities in the EU for 2014
Mineral deposits, occurrences and showings	BRGM, 2016, ProMine project (EU 28)	http://promine.gtk.fi/.	Occurrences and showings of mineral deposits in Europe
Exploration budget by world region and commodity	SNL Metals & Mining, exploration budget survey (EU 28 and regional)	http://www.snl.com/	The budgets allocated to metallic mineral exploration between 1997 and 2015.
Criticality Figure (2-D)	EC CRM assessment	http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/crm-report-on-critical-raw-materials_en.pdf	
Cradle-to-gate environmental implications	ELCD	http://eplca.jrc.ec.europa.eu	Metals data only available for: Cu, Al, sand, Steel (hot rolled, rebar, sections, galvanized), Pb, Gravel, Gypsum, Lime, Wood, Average rubber, Stainless steel, Pine wood, Spruce wood.

Information	Source	Website	Details
Recycling rates	EC CRM Assessment	http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical/	
In-use stocks	MSA	https://ec.europa.eu/growth/tools-databases/msa/content/introduction	
Sankey Diagram	MSA	https://ec.europa.eu/growth/tools-databases/msa/content/introduction	
Trade agreements with the EU	European Commission	http://ec.europa.eu/trade/policy/countries-and-regions/agreements/	
Export Restrictions on Raw Materials	OECD (collected for CRM 2017 update)	http://qdd.oecd.org/subject.aspx?Subject=ExportRestrictions_IndustrialRawMaterials	It provides export restrictions (export taxes, prohibitions, licensing requirements, etc.) imposed by the governments worldwide onhe export of industrial raw materials (minerals, metals and wood), detailed by country and product group. Product groups are defined at HS 4-, 6-, 8- and 10-digit codes and BEC stage of production acocrding to BEC classification.
Commodity Prices	SNL	http://www.snl.com/	
Commodity reports	SNL	http://www.snl.com/	News reports by material
Economic Importance	Annual detailed enterprise statistics for industry, code sbs_na_ind_r2, Eurostat's Structural Business Statistics		Value added at factor cost of materials

Information	Source	Website	Details
Annual industrial R&D investment	EU Industrial R&D Investment Scoreboard, .	http://iri.jrc.ec.europa.eu/scoreboard.html	The aggregated R&D expenditures of 41 companies relevant to the field of raw materials
Emissions of greenhouse gases	Word Input Output Database (WIOD) Air Emission Accounts and Socio Economic Accounts	http://www.wiod.org/new_site/database/eas.htm	A selection of production-corrected emissions to air from economic subsectors within the raw materials industry
Emissions of gases with tropospheric ozone formation potential	Word Input Output Database (WIOD) Air Emission Accounts and Socio Economic Accounts	http://www.wiod.org/new_site/database/eas.htm	A selection of production-corrected emissions to air from economic subsectors within the raw materials industry
Intra-EU waste trade	EEA, 2012, 'Movements of waste across the EU's internal and external borders', European Environment Agency report No 7/2012.		Waste Imports and Exports
Waste Exports out of the EU excl. to Asia	EEA, 2012, 'Movements of waste across the EU's internal and external borders', European Environment Agency report No 7/2012.		Waste Imports and Exports

Information	Source	Website	Details
Waste Exports from EU Member States to Asia	EEA, 2012, 'Movements of waste across the EU's internal and external borders', European Environment Agency report No 7/2012.		Waste Imports and Exports
Waste Exports and imports out of/into the EU (value)	EEA, 2012, 'Movements of waste across the EU's internal and external borders', European Environment Agency report No 7/2012.		Values and volumes of the imports and exports of selected key waste materials traded across EU borders in 2011.
Waste Exports and imports out of/into the EU (volume)	EEA, 2012, 'Movements of waste across the EU's internal and external borders', European Environment Agency report No 7/2012.		Values and volumes of the imports and exports of selected key waste materials traded across EU borders in 2011.
EU End-of-life recycling input rate (EOL-RIR)	Calculated based on material flow data from Bio by Deloitte, 2015, 'Study on Data for a Raw Material System Analysis: Roadmap and Topean Commission, DG		

Information	Source	Website	Details
	GROW. F		
Global End-of-life recycling input rate (EOL-RIR)	UNEP, 2011, 'Recycling rates of metals'.		
Global End-of-life recycling input rate (EOL-RIR)	Ad hoc Working Group on defining critical raw materials, 2014, 'Report on critical raw materials for the EU', prepared for the European Commission, DG Enterprise and Industry (GROW) (Annexes)		
Reuse of WEEE	Eurostat data on WEEE (EU 28)	http://ec.europa.eu/eurostat/en/web/products-datasets/-/ENV_WASELEE.	
	Eurostat data on WEEE (EU 28)	http://ec.europa.eu/eurostat/en/web/products-datasets/-/ENV_WASELEE.	
	IEC standard (IEC 62635)	https://webstore.iec.ch/publication/7292	Recyclability of materials from waste of electrical electronic products (WEEE) (Partial / under development)
	JRC report 2016 led with TUBerlin (under registration)	Under development	Recyclability of materials from waste of electrical electronic products (WEEE) (Partial / under development)

Information	Source	Website	Details
Total recycling and reuse	Eurostat data on WEEE (EU 28)	http://ec.europa.eu/eurostat/en/web/products-datasets/-/ENV_WASELEE.	
Products put on the market	Eurostat data on WEEE (EU 28)	http://ec.europa.eu/eurostat/en/web/products-datasets/-/ENV_WASELEE.	
Waste collected	Eurostat data on WEEE (EU 28)	http://ec.europa.eu/eurostat/en/web/products-datasets/-/ENV_WASELEE.	
Waste collected from households	Eurostat data on WEEE (EU 28)	http://ec.europa.eu/eurostat/en/web/products-datasets/-/ENV_WASELEE.	
Substitutability	EU Criticality Assessment	http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/crm-report-on-critical-raw-materials_en.pdf	
Producers (companies)	SNL	http://www.snl.com/	Mineral exploration, extraction, processing companies, steel factories
Materials Used (Upstream)	EU Criticality Assessment	http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical/	
Sectors Used By (Downstream)	EU Criticality Assessment	http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical/	

Information	Source	Website	Details
Patents	European Patent Office	https://www.epo.org/index.html	The number of patent applications in the raw materials sector between 2000 and 2011 from the EU-28 Member States and a group of six major industrialised non-EU countries
	Eurostat's Europroms dataset (EU-28)	http://ec.europa.eu/eurostat/web/prodcom/data/database	Eurostat's Europroms datasets are a combination of production and external trade data and consist of Prodcom datasets and COMEXT datasets. 1. Prodcom is the EU production statistics of about 3900 8-digit code products from Mining and quarrying and Manufacturing sectors (i.e., sections B and C in NACE Rev. 2), whose geographical scope is European Union + Norway + Iceland. Based on the reported national data, Eurostat's Prodcom provides data EU-28 and EU-27 totals on: i) volume of Sold Production (annual data);ii) (for some products) volume of Total Production (i.e., including product stock addition); iii) value of production sold (annual data); iv) unit value; v) imports and exports. Prodcom product codes are linked to CPA 2008, NACE Rev. 2 to Combined Nomenclature headings, thereby enabling to relate data on production to economic sectors and trade data.
	COMEXT	http://epp.eurostat.ec.europa.eu/newxtweb/	COMEXT provides trade exports and imports by detailed commodity and partner country. For individual countries the trade with all partners, both intra- and extra-EU, is aggregated to provide the total external trade for the country. For calculating the EU totals in relation to the rest of the world, only extra-EU partners are aggregated. Europroms' trade data, by CN heading, are aggregated to provide data equivalent to a certain Prodcom heading.
	The United Nations Commodity Trade Statistics Database (UN Comtrade) (Global)	http://comtrade.un.org ; http://comtrade.un.org/labs	Provides detailed annual international trade statistics (imports, re-imports, exports, re-exports) by commodities and partner countries from 1962 onwards. UN Comtrade Analytics provides an interactive visualization tool of time-series data that reflect the most recent trade data available in UN Comtrade.International Trade Centre (ITC) provides indicators on export performance, international demand, alternative markets and competitive markets, as well as a directory of importing and exporting companies. The monthly, quarterly and yearly trade flows are available from the most aggregated level to the tariff line level.

Information	Source	Website	Details
	The World Integrated Trade Solution (WITS) (Global)	http://wits.worldbank.org/Default.aspx?lang=en	World Integrated Trade Solution (WITS), conjointly developed by the World Bank and the United Nations Conference on Trade and Development (UNCTAD), in consultation with other international organizations such as International Trade Center, United Nations Statistical Division (UNSD) and the World Trade Organization (WTO), allows accessing information on trade, tariffs and non-tariff measures (NTM), based on data provided by: the UNSD Commodity Trade's UN Comtrade database, which contains commodity trade exports and imports data; - the WTO's Integrated Data Base (IDB), which contains imports by commodity and partner countries and Most Favored Nation (MFN) applied and data on preferential tariffs at the most detailed commodity level of the national tariffs. - The World Bank et al.,which provide information on preferential trade agreements (PTAs) around the world, including agreements that have not yet notified to the WTO. THe Trade Outcomes module allows to calculate indicators of country's competitiveness.
	WTO's datasets on Regional trade agreements (RTA database) and Preferential trade arrangements(PTA databse) (Global)	https://www.wto.org/english/tratop_e/region_e/rta_pta_e.htm	Information on regional trade agreements (e.g. free trade agreements and customs unions) and preferential trade arrangements (i.e.non-reciprocal preferential schemes implemented by WTO Members.) in force in which are involved WTO member countries.
Net exports of mining equipment	Freedonia, 2015, 'World Mining Equipment — Demand and Sales Forecasts, Market Share, Market Size, Market Leaders'. See methodological notes for further details.	Data by request	Mining Equipment production

Information	Source	Website	Details
Educational programmes related to raw materials	Sand, A., Rosenkranz, J., 2014, 'Education related to mineral raw materials in the European Union', COBALT project "COmmunicating, Building of Awareness, Leadership competence and Transferring knowledge on sustainable use of raw materials" D3.1.		
Qualification level in the mining and quarrying sector	EU Skills Panorama	http://skillspanorama.cedefop.europa.eu/en.	
Participation in education and training in the mining and quarrying sector	EU Skills Panorama	http://skillspanorama.cedefop.europa.eu/en.	
Social: Public perception of the effort of various types of companies towards society by country	2013 Flash Eurobarometer 363,'HOW COMPANIES INFLUENCE OUR SOCIETY: CITIZENS' VIEW' (EU 28 MS and Other countries)	http://ec.europa.eu/public_opinion/flash/fl_363_en.pdf	The general public's trust in the commitment towards society of companies from various sectors, including Mining

Information	Source	Website	Details
Incident rate of non-fatal accidents by economic sector	Non-fatal accidents at work by economic activity and sex, code hsw_n2_01, incidence rate,	http://ec.europa.eu/eurostat/en/web/products-datasets/-/HSW_N2_01.	
Companies adhering the Global Reporting Initiative by year, region and sector	Global Reporting Inititative Sustainability Disclosure Database,	https://www.globalreporting.org/services/Analysis/Reports_List/Pages/default.aspx	The number of companies that have joined the GRI in different raw materials sectors, namely mining, metals products, forest and paper products, and construction materials.
Number of employees	Industry by employment size class statistics (NACE Rev. 2, B-E), code sbs_sc_ind_r2. and Eurostat's Structural Business Statistics (EU 28)		

Annex 3: Timeline of potential knowledge providers

The following table provides an overview of the timeline of potential knowledge providers to the RMIS.

Table 7: Timeline of potential RMIS knowledge providers

Project	Type	Before 2009	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	After 2018
The Executive Agency for Small and Medium-sized Enterprises (EASME)	European Commission (Agency/Project)												
European Environment Agency (EEA)	European Commission (Agency/Project)												
EIP SIP commitment consortia on raw materials	European Commission (Agency/Project)												
European Institute of Innovation and Technology (EIT)	European Commission (Agency/Project)												
European Securities and Markets Authority (ESMA)	European Commission (Agency/Project)												
European Raw Materials Knowledge Base - Knowledge Base Architecture (EURMKB-KBA)	European Commission (Agency/Project)												
EUROSTAT	European Commission												

	(Agency/Project)												
Material System Analysis (MSA)	European Commission (Agency/Project)												
The European Agency for Safety and Health at Work (EU-OSHA)	European Commission (Agency/Project)												
European Chemicals Agency	European Commission (Agency/Project)												
Network on the Industrial Handling of Raw Materials for European Industries (ERA-MIN)	FP7 and Horizon 2020												
EU Rare Earth Sustainable Exploitation (EURARE)	FP7 and Horizon 2020												
EIT Raw Materials and Sustainability Support and Information Centre (SSIC)	FP7 and Horizon 2020												
Combined Heat, Power and Metal extraction from ultra-deep ore bodies (CHPM2030)	FP7 and Horizon 2020												
Critical Raw Materials Innovation Network (CRM Innonet)	FP7 and Horizon 2020												
European Institute of Innovation and Technology (EIT) Manufacturing	FP7 and Horizon 2020												

Integrated innovative metallurgical system to benefit efficiently polymetallic, complex and low grade ores and concentrates (INTMET)	FP7 and Horizon 2020												
European Union's International Observatory for Raw Materials (INTRAW)	FP7 and Horizon 2020												
Mineral Intelligence Capacity Analysis (MICA)	FP7 and Horizon 2020												
MINATURA2020	FP7 and Horizon 2020												
Minerals4EU	FP7 and Horizon 2020												
Minerals Policy Guidance for Europe (MIN-GUIDE)	FP7 and Horizon 2020												
New Mine - EU Training Network for Resource Recovery Through Enhanced Landfill Mining	FP7 and Horizon 2020												
Prospecting Secondary raw materials from the Urban Mine and Mining (PROSUM)	FP7 and Horizon 2020												
Solution for Critical Raw Materials – a European Expert Network (SCRREEN)	FP7 and Horizon 2020												

SMART data collection and inteGRation platform to enhance availability and accessibility of data and infOrmation in the EU territory on SecoNDary Raw Materials (SMART GROUND)	FP7 and Horizon 2020												
Vision and Roadmap for European Raw Materials (VERAM)	FP7 and Horizon 2020												
MIN-GUIDE (Guidance for innovation friendly minerals policy in Europe)	FP7 and Horizon 2020												
NordMin	Multilateral Member States initiatives												
Sustainable aggregates planning in South East Europe (SNAP SEE)	Structural Development and Cohesion Fund												
European Network of Mining Regions (ENMR)	Structural Development and Cohesion Fund												
H2020 call 2017 to optimize collection of raw materials data in Member States	FP7 and Horizon 2020												
Cost Action MINEA – Mining the European Anthroposphere	FP7 and Horizon 2020												
Strategic Dialogue on Sustainable Raw Materials for Europe (STRADE)	FP7 and Horizon 2020												

Minventory	public procurement project												
Permitting minerals in EU MS (MINLEX)	Public procurement project												

Annex 4: Raw Materials' Profiles & Supply Chains

Sub-tile 10.1: raw materials' profiles

The "Raw materials' profiles" sub-tile of the RMIS 2.0 main menu will provide access to quantitative and qualitative knowledge relative to the supply chains of a large number of (non-food, non-agricultural) raw materials. Users can choose whether to order the available raw materials alphabetically, from the periodic table of elements, or per-group (precious, rare & high-tech metals / base metals / industrial & construction minerals / biotic raw materials / others).

The content of the Raw Materials' Profiles tile of the RMIS 2.0 follows the structure presented hereafter and will include JRC visualisations (static and dynamic) and additional headings based on JRC elaborations. The underlying data are taken, where possible, from international, publicly available statistical sources, or from other accepted and credible sources.[30] Links to other RMIS sections (e.g. Critical Raw Materials, Economics & Trade, Environmental & Social Sustainability) will be provided as well.

Introduction and key facts

Resources and reserves

Supply

- ***Production (EU and Worldwide)***
- ***EU Imports*** (including links to the Economics & Trade tile)
- ***Secondary Raw materials*** (including links to the Secondary Raw Materials & Circular Economy tile)

Demand

- ***EU Exports*** (including links to the Economics & Trade tile)
- ***EU Consumption***

Applications / end-uses

Market and prices

Trade-related aspects (including links to the Economics & Trade tile)

EU supply chain (including a link to MSA sub-tile of this very tile)

Substitution-related aspects

Sustainability aspects (with link to the Environmental & Social Sustainability tile)

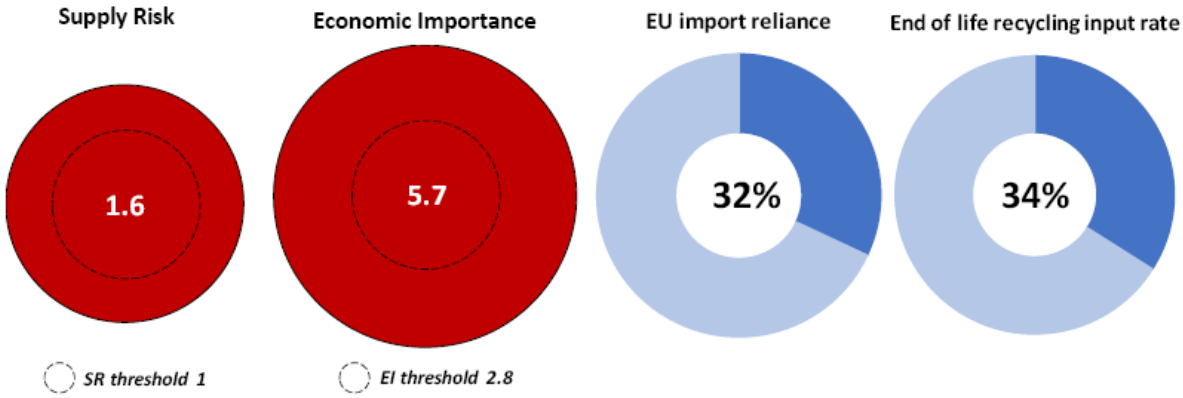
Outlook Supply and Demand (link to projects, Industry & Innovation tile)

Data sources and references

A preliminary example of how a given raw material's profile could look like in the RMIS 2.0 is presented hereafter for Cobalt.

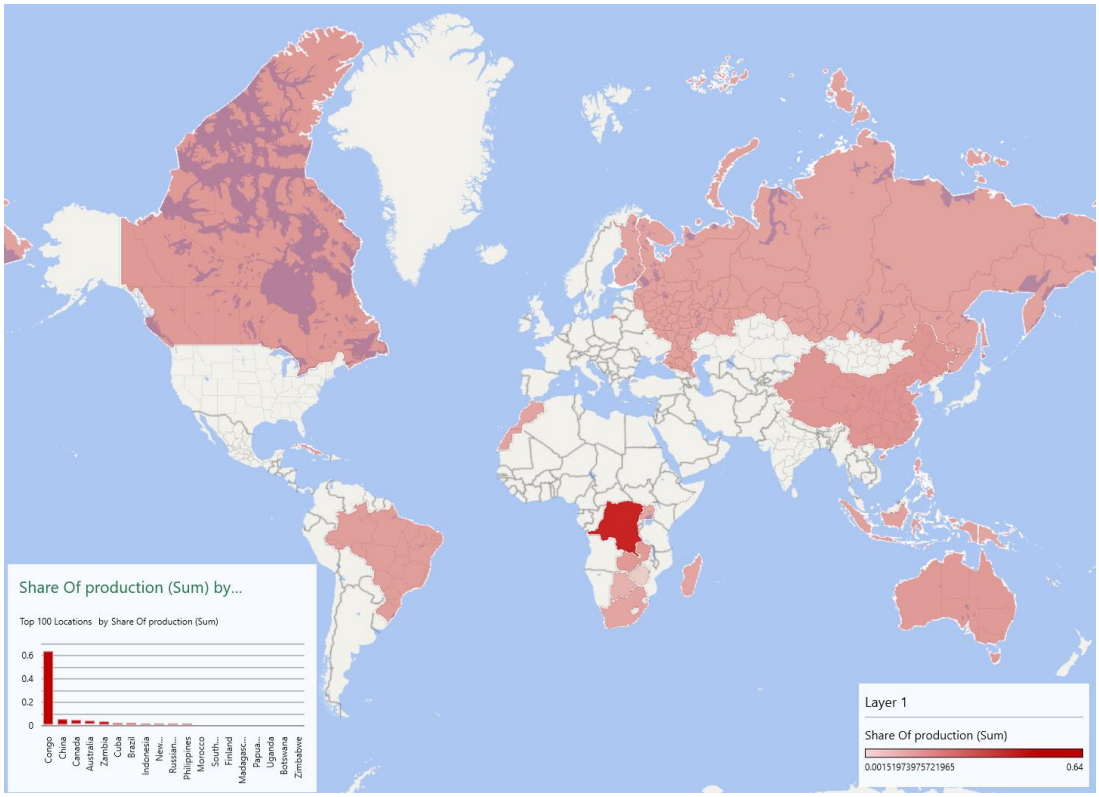
[30] As an example, at this stage we used information from the assessment exercise conducted in the context of the 2017 List of EU Critical Raw Materials.

COBALT



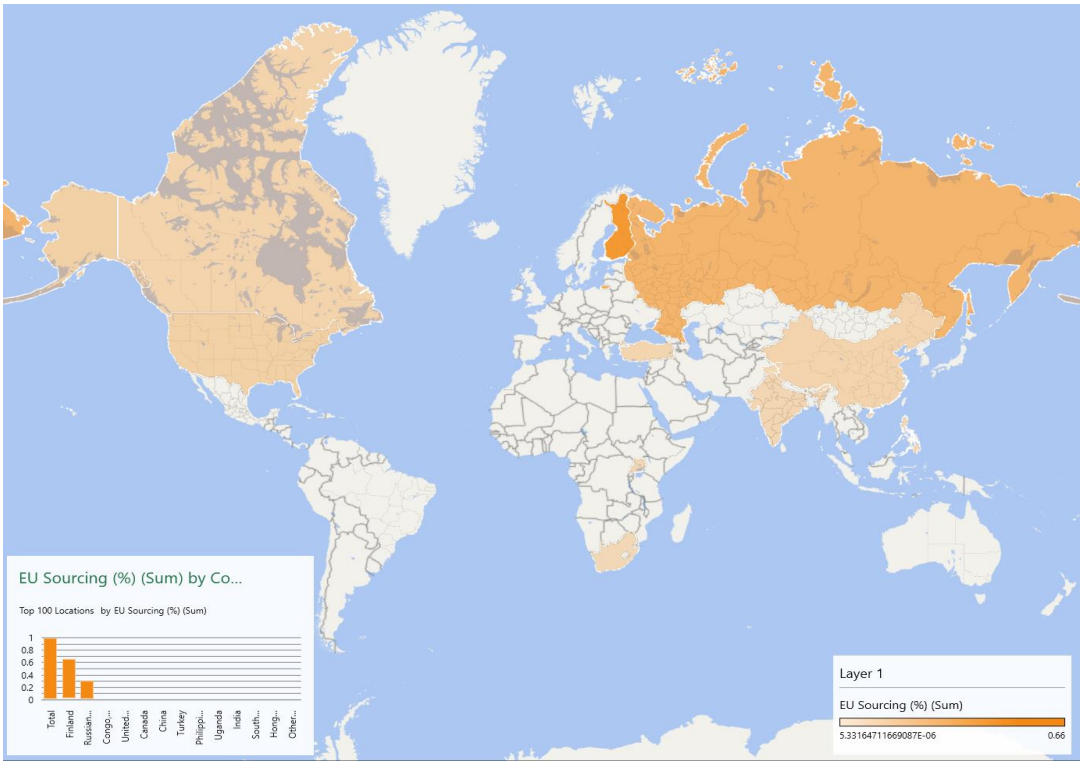
Links to (pop-up) bar charts showing all the raw materials ranked by: Economic Importance, Supply Risk, Import Reliance, Recycling rate (filters to be decided)

Global Production: major global supplier countries



World picture 1: major global supplier countries

EU Sorcing



World picture 2: major EU sourcing countries

Sub-tile 10.4: supply chain viewer

The goal of the supply chain viewer in RMIS is to provide an overview of the raw material supply chain network and allow users to enter factsheets for materials, countries, as well as selected product applications and sectors involved in the supply chain. Data for the linkages between countries – materials – product applications - sectors come directly from the EC criticality assessment, and updates are therefore possible with each publication of EC list of critical raw materials.

Note that for the illustrative examples below and for the time being, data come from the 2014 EC criticality assessment (which uses data for around 2010). In the future, information will be enlarged and updated to provide an entry point to the existing "raw materials' profiles" sub-tile and to the "country profiles" tile.

The steps of using the supply chain viewer are as follows:

Periodic Table of the Elements as a possible entry point to the raw material supply chains and related profiles

The user can select a material from the periodic table of the elements to visualize its supply chain (Figure 8). Note that only three supply chains have been generated so far (i.e., Aluminium (Al), Phosphorus (P), and Cobalt (Co)).[31]

Figure 8: Entry point to the material supply chains. Three material supply chains have been generated so far, highlighted in red color

[31] A prototype application can be found at http://rmis.jrc.ec.europa.eu/v2/fiches/

Explanation of the Supply Chain Structure

Each supply chain is based on information from the EU Criticality Assessment and consists of supply chain actors ("nodes") including **countries, materials, product application, and sectors** (Figure 9). Links ("edges") between the actors represent raw material flow (other types of relationships (e.g., contractual relationships, may also be displayed in the future). Currently, data from the 2014 criticality assessment are used to generate the supply chain graphs. We plan to update the graphs once the currently ongoing criticality exercise by DG GROW has been finalized. Note that the sectors are currently showing mega-sectors consisting of several 2- to 3-digit NACE sectors given in the 2014 criticality exercise.

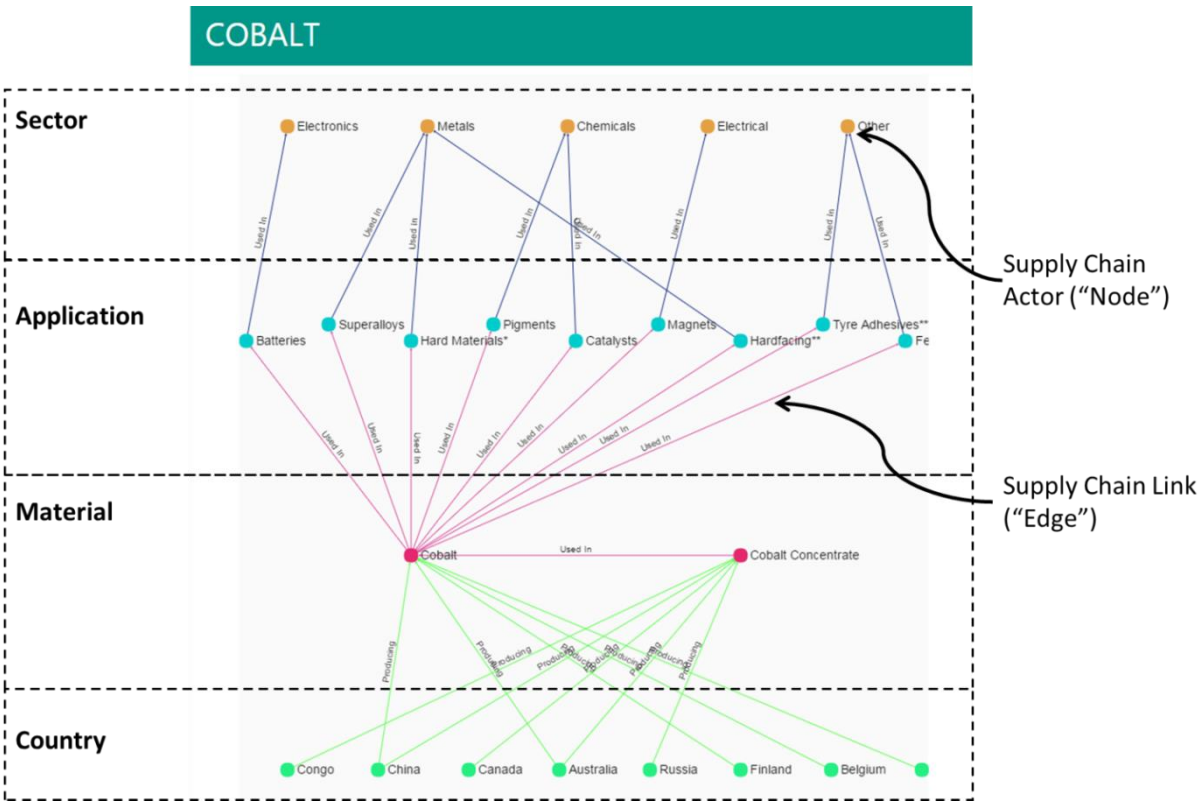


Figure 9: Structure of the material supply chains in RMIS consisting of countries, materials, applications, and sectors

Viewing information in RMIS: (1) Information derived from the supply chain network

Information can be obtained both from the supply chain network (which also helps to structure information) and from the factsheets that can be generated for each supply chain actor (see Annex 7 for an overview of information contained in the material factsheets, and Chapter 4.3.7 for information contained in the country profiles). As an example, "Cobalt concentrate" is selected to view the network from the perspective of this node (Figure 10).

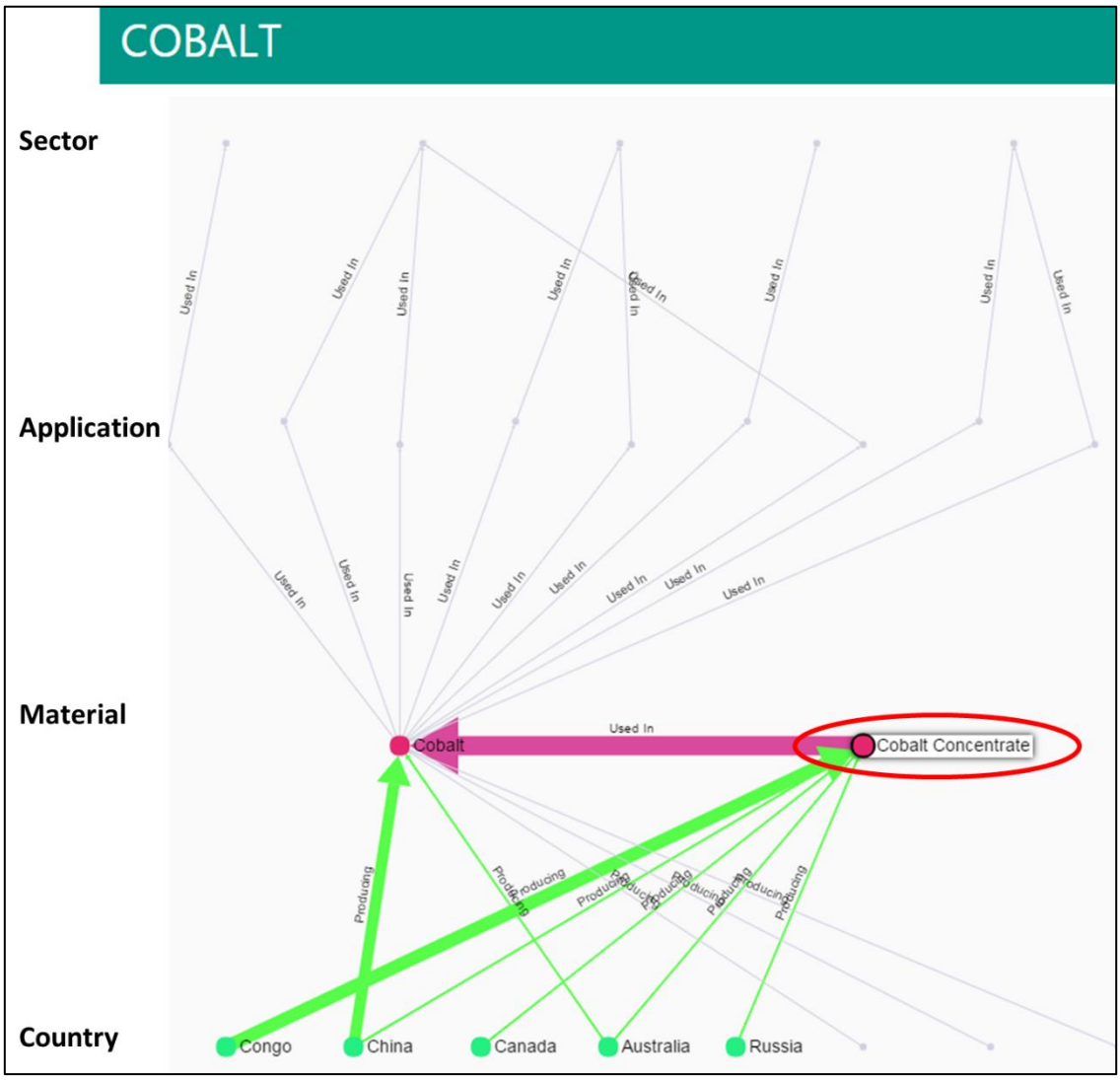


Figure 10: Supply chain network for a given raw material (in this example Co concentrate)

The width of the arrows shows the flow of cobalt (metal content) through the supply chain. Co concentrate is predominantly produced by DR Congo as shown by the width of the arrow (note that only the top 5 producing countries are shown. Co-concentrate is used only in the production of cobalt (consisting of metal, metal powder, oxide, hydroxide, salts). Certain countries (e.g., China and Australia) are involved in producing both, Co concentrate (mining) and Co (refining).

Viewing information in RMIS: (2) Information summarized in country profiles

Information can be obtained both from the supply chain network (which also helps to structure information) and from the factsheets (e.g., a country profile) that can be generated for selected supply chain actor (see next heading). As an example, "Congo" is selected to view relevant information below the supply chain diagram (Figure 11). More info on country profiles are given in Chapter 4.3.7.

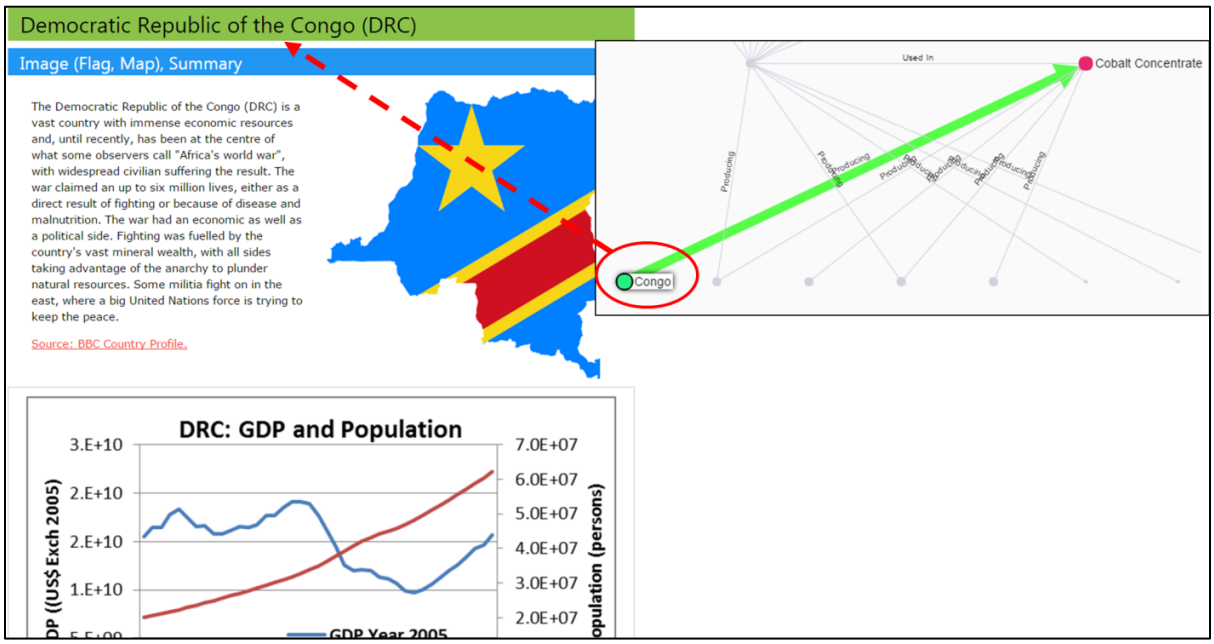
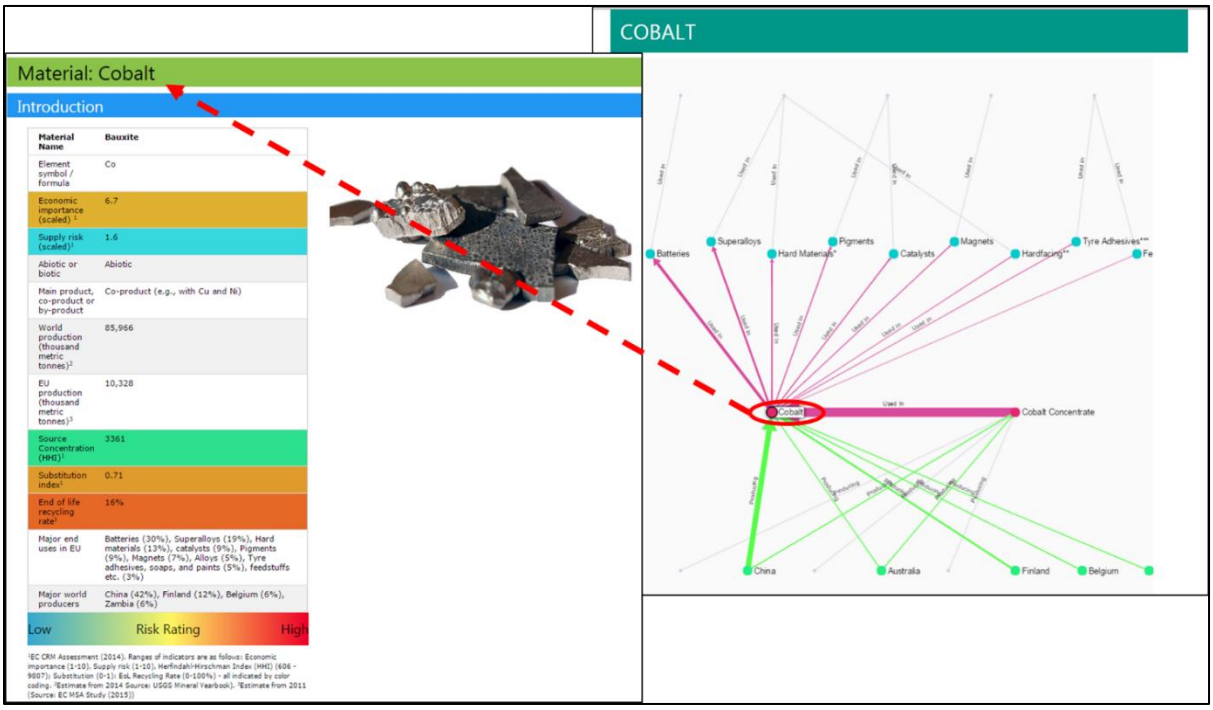


Figure 11: Country profile for DR Congo (generated by clicking on the country).[32]

Viewing information in RMIS: (3) Information summarized in material factsheets

Similarly to the previous step, Figure 12 shows how a material factsheet can be generated by selecting a single material in the supply chain viewer. As an example, "Cobalt" is selected as material node (actor) to link to the related material factsheet (shown below the supply chain diagram). The material factsheets are based on the information provided in the EU criticality assessment.



[32] The exact thematic areas that will be included in country profiles are further discussed in Chapter 4.3.7

Figure 12: Material factsheet for cobalt (generated by clicking on the country).

On the right hand side of Figure 12 the supply chain shows that cobalt (consisting of the metal, oxide, hydroxide, salts, etc.) is being predominantly refined in China, but important refining countries include also Belgium and Finland in Europe. Cobalt is used in a variety of applications (end-uses) including, e.g., batteries, superalloys, pigments, catalysts and others. On the left-hand side of Figure 12, relevant information in the form of a cobalt factsheet is shown. This includes an overview table with basis raw materials information such as criticality (supply risk and economic importance), world- and EU-production, substitution index, end-uses, etc.).

Viewing information in RMIS: (4) Information summarized in product application factsheets

The factsheets for product applications allows the user to include product-level information in the RMIS (Figure 13). As an example, the batteries application has been populated with some information on the materials used in batteries (i.e., Sb, Co, In, Li, Mn, natural graphire, REE (light), EU legislation (the Batteries Directive), and a section on Innovation & Market research (to be populated). For now, only factsheets for a few selected products will be developed which could be expanded in the future.

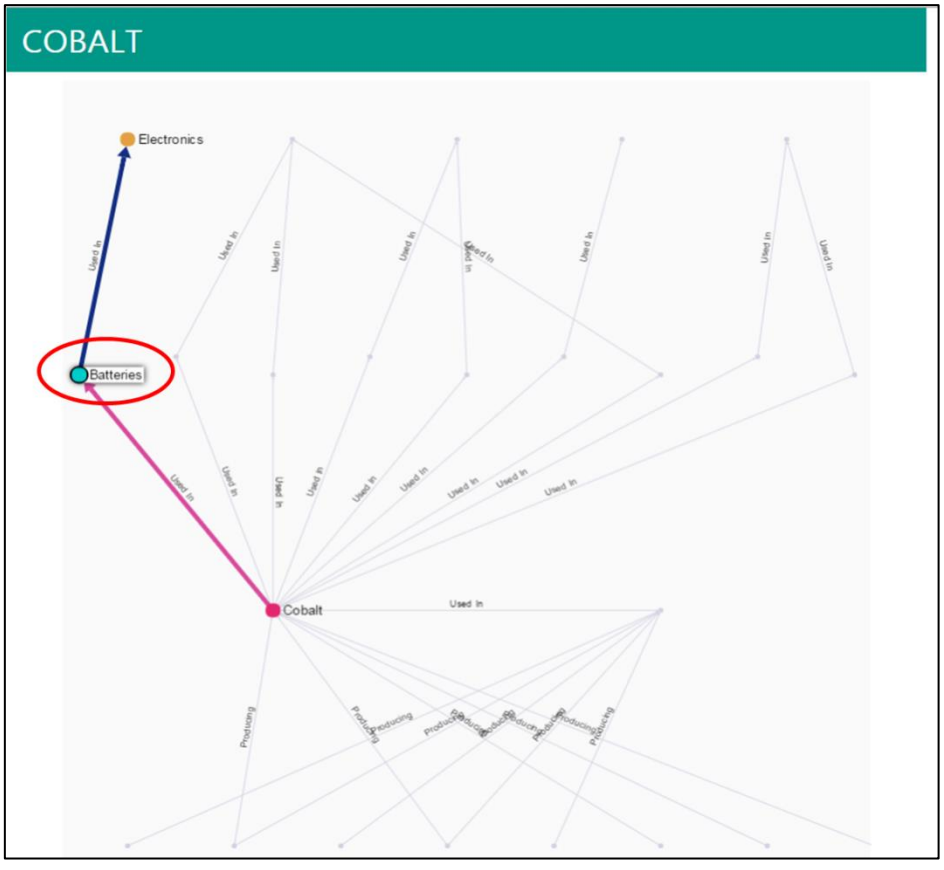


Figure 13: Application factsheet for batteries (generated by clicking on the application).

Viewing information in RMIS: (5) Information summarized in sector factsheets

The factsheets for sectors allows the user to include sector-level information in the RMIS (Figure 14). As an example, the chemicals mega-sector has been populated with information on the materials used in chemicals sectors, economic importance of the Megasector, and a link to chemicals regulation in the EU. Note that the current RMIS uses the megasectors from the 2014 EU criticality assessment, which consist of multiple 2- and 3-digit NACE sectors. For now, only factsheets for a few selected sectors will be developed which could be expanded in the future.

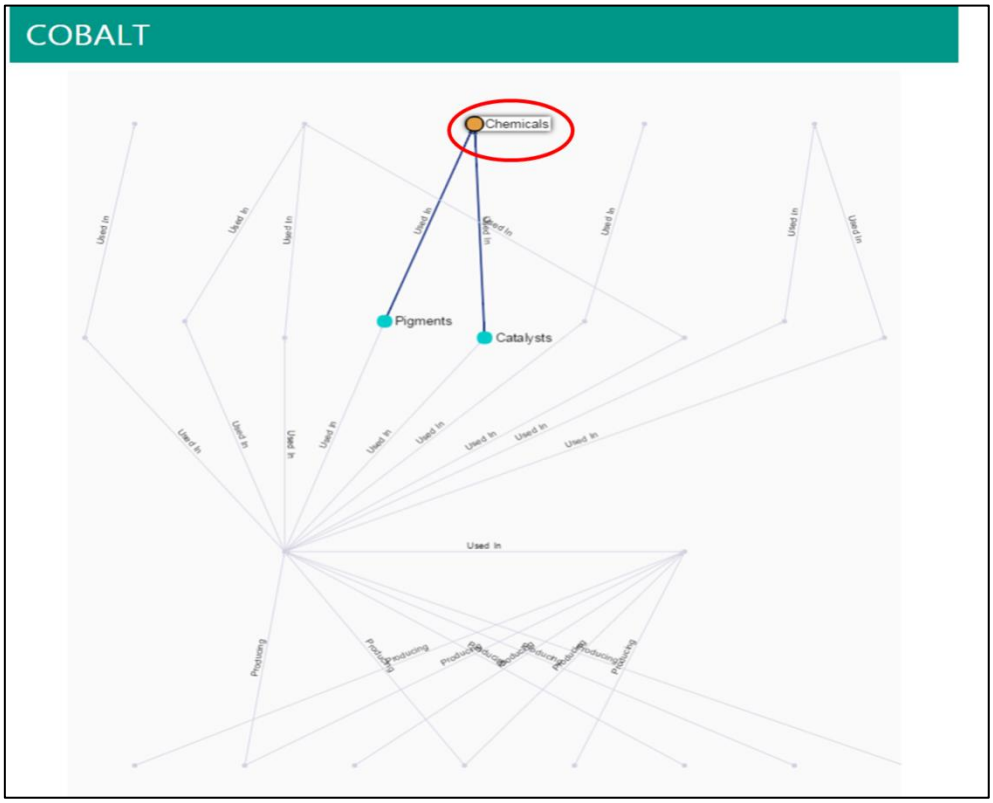


Figure 14: Sector factsheet for chemicals (generated by clicking on the chemicals sector)

Future outlook

Further population of the RMIS database could enable website users to **combine different material supply chains** with each other, show interlinkages, and highlight "important" actors based on their connectivity and position in the supply chain. An example is given for the combined supply chains of aluminium, cobalt, and phosphorus (Figure 15). Importance is determined by the number of linkages to any of the sectors (degree centrality) and shown by increasing node size. The chemicals sector is the most connected sector as it uses a variety of products (termed: applications) including catalysts, pigments, phosphate fertilizer, and animal feed supplement.

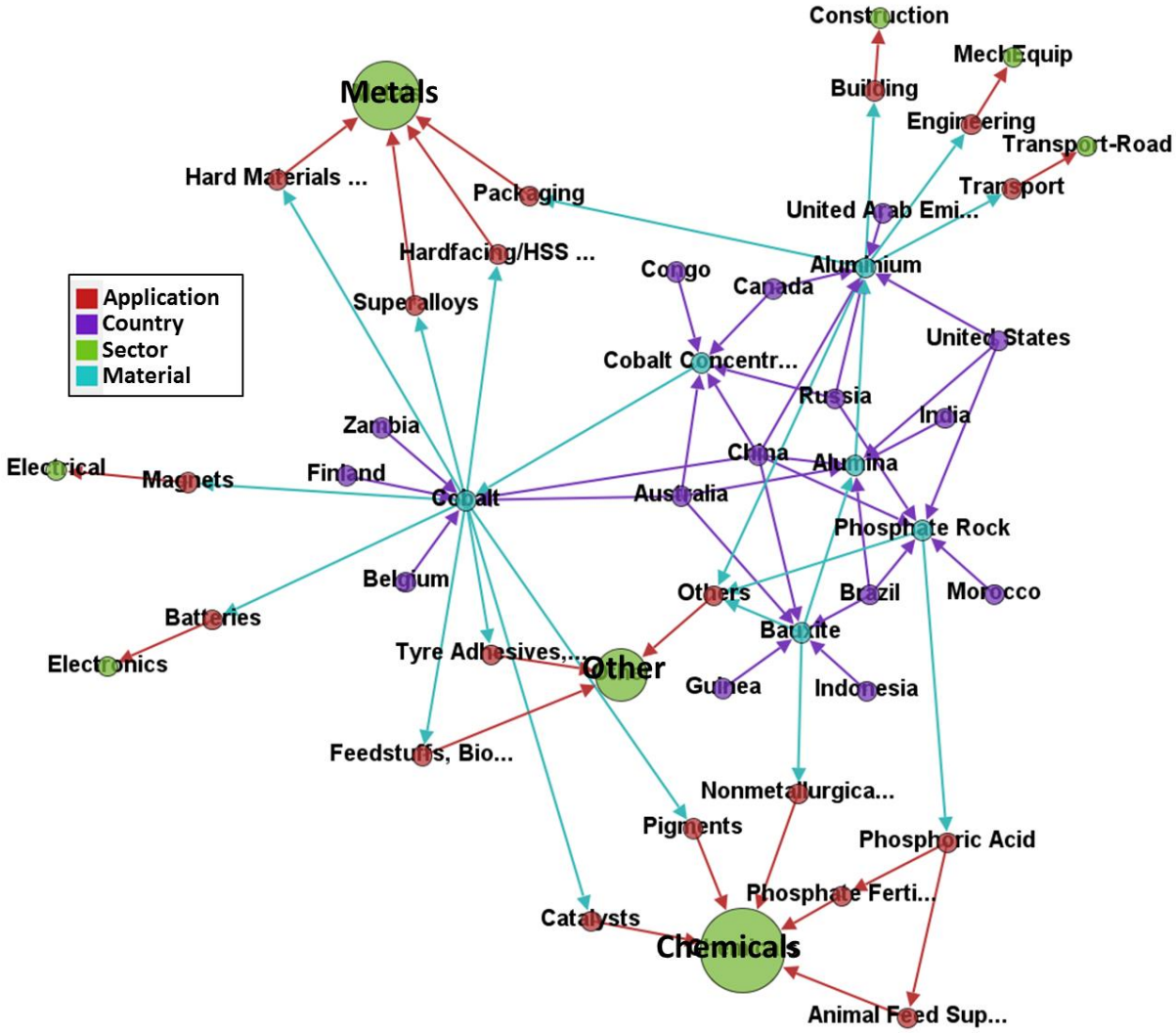


Figure 15: Identification of "important" mega-sectors in three combined supply chains (i.e., aluminium, cobalt, and phosphorus) in the RMIS supply chain viewer

Annex 5: Summary of the 1st International workshop on the EU Raw Materials Information System

Introduction

The European Union **Raw Materials Knowledge Base** (EURMKB) and, within its centre, the **Raw Materials Information System** (RMIS)[33] are established for identifying and serving key information and knowledge needs of governments, business and research stakeholders, as well as to facilitate knowledge dissemination on raw materials. The Conference "Towards a Reinforced Raw Materials Initiative" organised by the Dutch EU Presidency in April 2016, and numerous governments stressed that RMIS as an enhanced, long term, secured information system is fundamental in securing raw material supply.

RMIS, by clustering intelligence synergies and providing scientific and technical added value, is expected to satisfy its stakeholders and form a one-stop gateway information source and knowledge service centre. The Workshop brought together 65 leading representatives from 15 countries, 29% from Member States entities, 28% EU institutions, 24% industry, 17% academia and 2 % from international entities, with reference to both primary and secondary raw material flows across the whole value chain in response to the Action Plan on Circular Economy[34]. Further, JRC staff from Directorates D and C, E and I participated at the workshop.

This workshop was designed to comply with the requirements of most of the relevant aspects along the raw materials value chain, and it is planned to be organized annually. The hosting Joint Research Centre (JRC) of the European Commission (EC) is the permanent in-house scientific and technical service entity of EC.

In view of the above the Workshop targeted at:

- surveying stakeholders' information and knowledge needs, and priorities for EURMKB and RMIS functions and expected JRC added value services;
- mapping existing data, information and knowledge gaps along the supply chain with the ambition of combining primary and secondary raw material flows with foreign trade;
- discussing potential ways of EU level and international co-operation for efficient networking among major actors in raw materials data, information and knowledge services and utilization;
- outlining ways of establishing a platform of stakeholders, its mode of activities; and
- highlighting short-, and mid-term innovation ideas for related research needs in a broader context, such as European Innovation Partnership (EIP) and beyond.

The workshop also aimed at receiving feedback from stakeholders on the draft JRC Technical Report "Raw Materials Information System (RMIS): towards v2.0 - An Interim Progress Report and Roadmap" that had been circulated among the participants before the workshop. Comments provided during the workshop and in written form after the workshop will be addressed in the final version of the report.

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[33] The EU Raw Materials Information System (RMIS) was established by the JRC based upon the policy mandate provided by a coherent series of European Commission Communications on Raw Materials Initiative (RMI), European Innovation Partnership on Raw Materials (EIP), and Circular Economy, the latter is calling for the "*Further development of the EU raw materials information system*" in the context of secondary raw materials. The RMIS 1.0 was launched in March 2015 and its development started promptly by preparing a Concept Note on RMIS 2.0 that was acknowledged by the High Level Steering Group of EIP in July 2016. The Roadmap towards RMIS 2.0 will be published in early 2017.

[34] **Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Closing the loop - An EU action plan for the Circular Economy (COM/2015/0614 final)**

The workshop was a step for the establishment of a long-term European Union Raw Materials Knowledge Base partnership in line with the above objectives, building on:

- enhanced and fluent data and information flow between data providers and users;
- formulating ways to establish an RMIS advisory body, and a stakeholders' platform group with an option of later transformation into an EIP commitment consortium;
- facilitating the clustering and alignment of various networks and platforms related to raw materials data providers;
- interacting with scientific and technological think tanks, and existing co-operation frames designed to clustering raw materials and Circular Economy related R&D&I ideas and initiatives, such as EIT on Raw Materials;

with a focus on the EU and its Member States government entities, industry and international stakeholders.

Structure of the workshop agenda

The agenda was designed to cover the issues that are essential in the policy field and in the launch of RMIS2.0 during the one and half days. Nevertheless, by being the kick-off in line, the workshop did not target at an in-depth analysis of the different topics. Instead, the technical content of the agenda was structured into five sessions: on policy background, on primary raw materials, on secondary raw materials, on monitoring material flows, and on overarching topics. The keynotes were followed by session-specific RMIS demonstrations of its off-line test version, and thematic discussions. The last session involved specific new policy demands, industry and Member States views.

Key findings

Participants acknowledged:

- the importance of RMIS as a key block of the European Union Raw Materials Knowledge Base (EURMKB) that will support the EU raw materials policy and promote activities in the EU raw material sector;
- the transition of RMIS 1.0 into an upgraded, more comprehensive RMIS 2.0 version for which there is support from most stakeholders;
- the careful preparation and organization of this workshop on RMIS with the objectives that facilitated interaction among stakeholders and building common understanding.

RMIS2.0 was welcomed for:

- having the ambition of covering the whole raw material value chain;
- considering the approach of focusing primarily on EU policy-demanded services and the related JRC science and technology areas, such as materials flows analysis and secondary raw materials;
- its targeted aim on providing long lasting access to information generated by FP7 and H2020 projects;
- its tabloid-friendly Responsive Web Design;
- striking the path towards added value applications with dynamic features (e.g. supply chain viewer, regulatory country profiles) that relevantly complement other types of data and reports;
- taking a key role as the European gateway (entry web portal or hub) to raw materials information and knowledge, and to existing external information services; and as such

- its co-ordination efforts in bringing interested stakeholders' together in the development and maintaining of the EU RMKB.

Beyond the major issues discussed, many addressed other important aspects, such as that RMIS2.0 shall:

- target at meeting primarily the needs of EU and MS decision makers for data, information and intelligence; secondarily, the public interest shall also be captured in the RMIS; then, the dialogue with the industry by providing scientific evidence should be facilitated;
- firstly, assist the EU ex-ante policy making, and secondly the ex-post monitoring;
- efficiently link with other relevant and complementary platforms (e.g. GeoERA, and MS level services) while keeping in mind the subsidiarity principle;
- primarily focus on serving the EU level data needs from the EU data sources, but also tackle the global scale where and when appropriate (ie. RMI first pillar, trade, etc.);
- promote relevant data and information classification, harmonization, standardization, such as use of the mandatory INSPIRE legislation and protocols and the voluntary initiatives of other international standards;
- address consistency, completeness and quality of data, including through expert judgments;
- act carefully and perform good practice in the field of public information, business secret, confidential and other classified data, and intellectual property rights;
- not only address data but also their analysis and interpretation since the latter is needed to "enlighten policy-making"; integrate predictive data, like forecasting
- link CRM and Scoreboard applications and datasets, both based on MSA approach, with other material flows analysis data, including stocks;
- accept industry as a collaborator with regard to the release of data and information;
- elaborate a mid-, and long-term master plan ("business plan", strategy);
- have initially more focus on data concerning secondary raw materials that pose more challenges than of primary raw materials, concerning completeness and quality, and also in view of supporting actions for circular economy; various possible source of data (e.g. information from recyclers, from take-back schemes, from manufacturers, international study groups on materials, ProSum) should be explored further; and have a focus on specific sectors and waste flows (e.g. WEEE, end-of-life vehicles, batteries, mining waste, packaging);
- not only to provide data and information from diverse databases and sources, but also to combine them in a way that is useful for its stakeholders;
- consider the defense industry, and EU international development priorities as further sectors to be covered.

Potential implications of the workshop findings

On the short-term (2017-2018+), RMIS2.0 shall focus on

- further developing its web-surface content to achieve a close-to-complete thematic coverage of the raw materials value chain applying scientific and technical excellence but also with a view on public outreach;
- maintaining and developing its EU Community policy-driven applications such as the Scoreboard, CRM, MSA, Trade flows pilot, respectively, and linking their datasets;

- providing a suitable facility (interface) to accommodate, organize and serve EU RMKB information flows, with a distinguished care on the H2020 projects' output;
- establishing a meta database ("library") with flexible search functions, and internal protocol on data confidentiality and IPR conditions;
- analyzing further the core needs and the development of the RMIS database, with a prime focus on policy support;
- extending the RMIS stakeholders platform via the organization of the annual workshops and webinars, as well, considering the establishment of an advisory body, and advisory sub-groups if needed;
- developing from a static information system towards a more dynamic one;
- continued building connections to the member states, and searching for options of collaboration.

Annex 6: Building the RMIS library

Full reference of report (authors, year, title, publisher, pages, etc.) (there shall be search options for words in title)	**Source**(weblink)	**Geographical coverage*** (11+27 filters)	**EIP SIP relevance****(7 priority filters)	**Thematic coverage along value chain***** (ca. 10-20 filters)	**RMIS topics covered****** (6 filters)	**Raw material coverage******* (31+ca.90= ca. 120 filters)	**UPLOAD/SEARCH BUTTON**

***filters:** N-America, S-America, Africa, European Union, 27 EU MS, Rest of geographical Europe (ROE), Mid-East, Far-East, Australia & New-Zealand, Oceania and global marine waters out of national EEZs (Exclusive Economic Zone) under the jurisdiction of the International Seabed Authority, Arctic and Antarctic, all global

****filters**: research & innovation, technologies for raw materials production (exploration, extraction, processing, recycling), substitution (materials for green energy technologies, for electronics, for extreme conditions, for large streams), improving EU RM framework (policy, access to deposits, public awareness), improving EU waste management framework (product design, quality recycling, illegal waste shipment, optimized recovery), knowledge & skills & Material Flows (knowledge base, EIT Community, optimized material flows); international cooperation (technology, governance, dialogues, health & safety & environment, skills & education & knowledge, investments)

*****filters**: exploration (incl. survey, prospection too), extraction, primary and secondary processing, mine closure (incl. remediation, aftercare) production (incl. fabrication, design, material efficiency, substitution, replacement), distribution (incl.

sustainable consumption, material dissipation), waste management (secondary raw materials), legislation (incl. policies, standards, harmonization), economics (finance, fiscal, trade), environmental sustainability (SEA, EIA, PEF, LCA, etc.), social sustainability (inc. public awareness, resilience), information systems, sector-specific, circular economy, competitiveness & innovation

******filters**: Policy & Legislation, Terminology & Library (incl. harmonization), CRM, MSA, Raw Materials Scoreboard & Other Indicators, Critical Raw Materials, Environmental & Social Sustainability, Economics & Trade, Secondary Raw Materials & Circular Economy, Industry & Innovation,

*******filters**:

1.1.1.1.1. Biotic (non-energy, non-agriculture) raw materials

1.1 Aquatic
1.2 Forest
1.2.1 Roundwood
1.2.2 Cork
1.2.3 Natural rubber
1.2.4 Other biotic raw materials

1.1.1.1.2. Non-biotic non-energy primary raw materials

2.1 Metalliferous
2.1.1 Base metals
2.1.2 REE
2.1.3 Precious metals
2.2 Non-metalliferous
2.2.1 Industrial minerals
2.2.1.1 Chemical use minerals
2.2.1.2 Physical use minerals
2.2.2 Construction minerals
2.2.2.1 Aggregates (crushed rock, sand, gravel, clay)
2.2.2.2 Ornamental (decoration) stones
2.2.3 Gemstones
2.3 Critical raw materials
2.4 Conflict minerals
2.5 Marine minerals
2.6 Other primary raw materials (He, H, fossil fuels of non-energy use, …)
3 Secondary raw materials
3.1 Extractive waste
3.2 Construction and demolition waste (incl. wood)
3.3 Power plant, steel works, waste incineration ash and slags
3.4 Rubber (tyre) waste
3.5 Wood mills waste
3.6 Packaging waste (incl. paper and plastic)
3.7 Paper waste
3.8 Urban and hazardous (other unspecified industry) waste
3.9 WEEE
3.10 EoL vehicle waste
3.11 Batteries

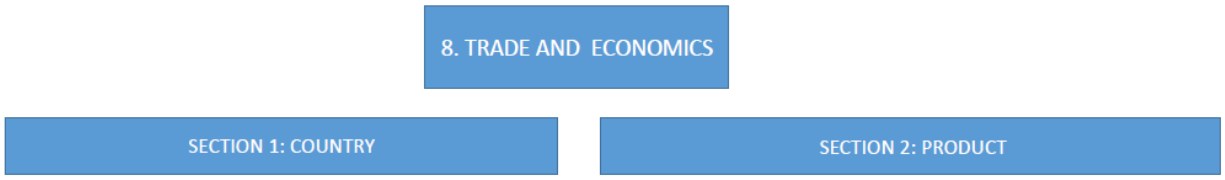
Annex 7: Preliminary description of the RMIS' economics & trade

Business economy is the traditional user of metals and minerals and intermediates made of them for producing an increasing variety of goods. Differences between countries in raw materials endowment, high concentration of their global production and supply and continuous emergence of technology-induced products make raw materials increasingly important.

Data on investments, production and trade of raw materials are provided by various international organisations, e.g., Eurostat, USGS, BGS, UNSD Comtrade, etc. However, a database exclusively and comprehensively covering country- and product-level data on non-energy and non-food raw materials commodities (i.e., non-energy and non-food raw materials and intermediates) does not exist.

The *objective* of RMIS' Economics & Trade section is to build a production- and trade-related database specific to non-food and non-energy raw materials, which to serve as a basis for i) creating country- and product-level visualization tools and ii) further develop performance indicators related to production, trade and investments in raw materials sector (i.e., raw materials plus intermediates).

RMIS' Trade and Economics section organizes data around non-food and non-energy raw materials, being divided into two main modules, i.e., *Country* and *Product*, which will also to be used as general filters in data query.



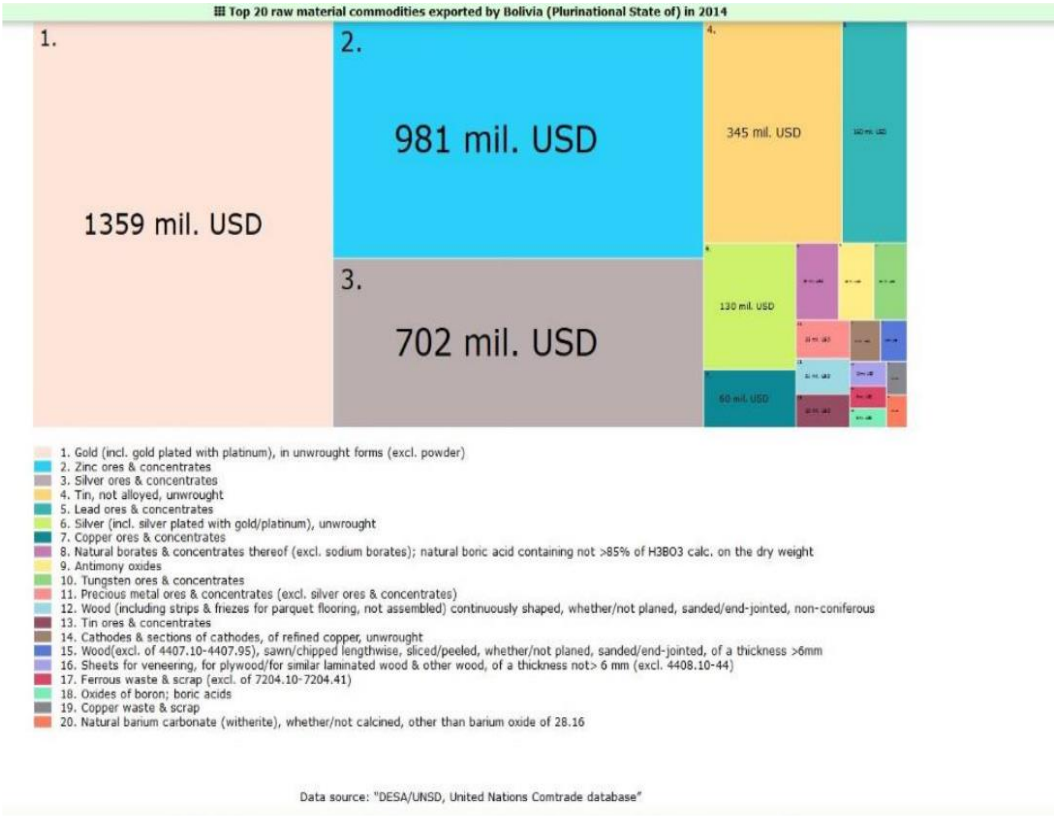
Methodological overview

Country module contains five modules: i) Raw materials trade flows; ii) Trade agreements; iii) Raw material production; iv) FDI stocks and flows and v) Trade performance indicators.

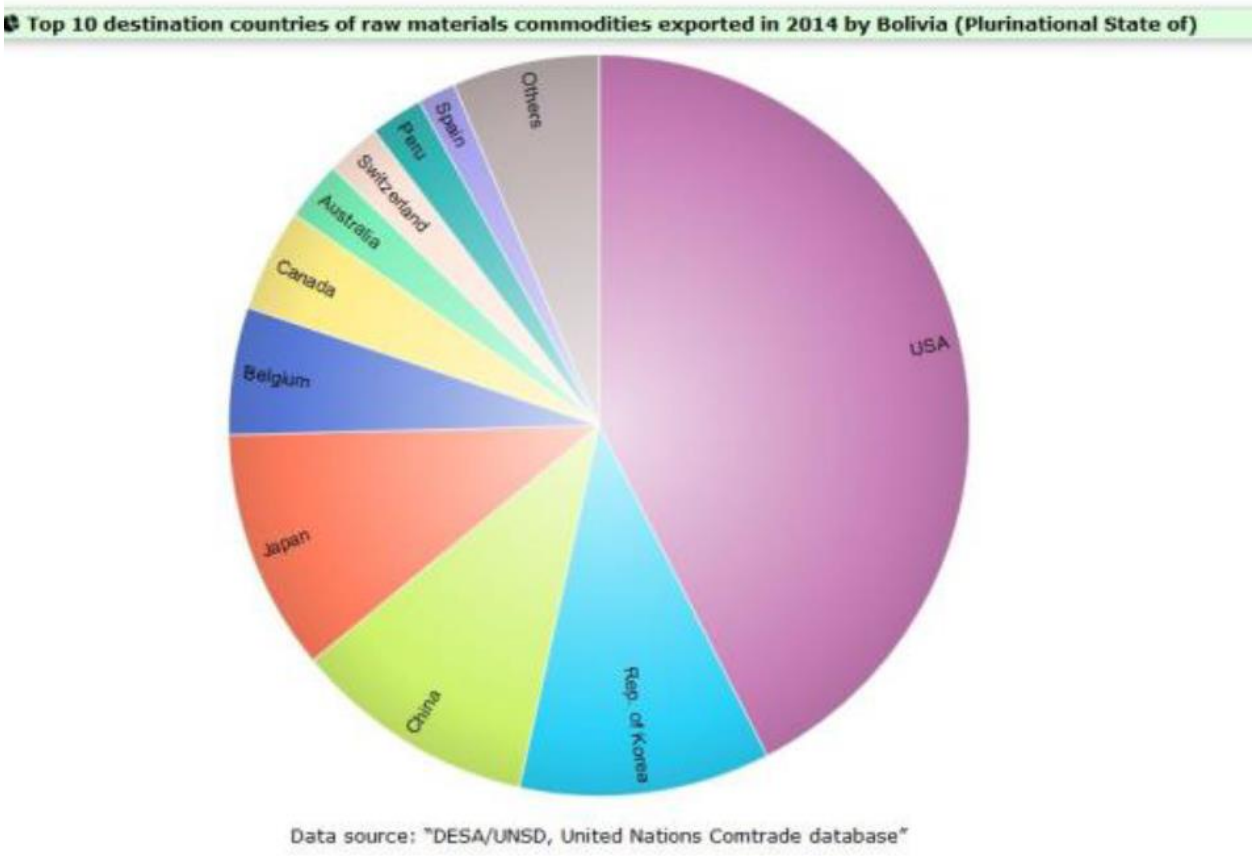
Country module's first sub-module, *Country's raw materials trade*, presents visualizations of trade profiles for 154 countries and EU-28 concerning non-energy and non-food raw materials import and export flows, export restrictions and tariffs, having the structure detailed below.

i) *Exports of non-energy and non-food raw material commodities in 2014* presents:

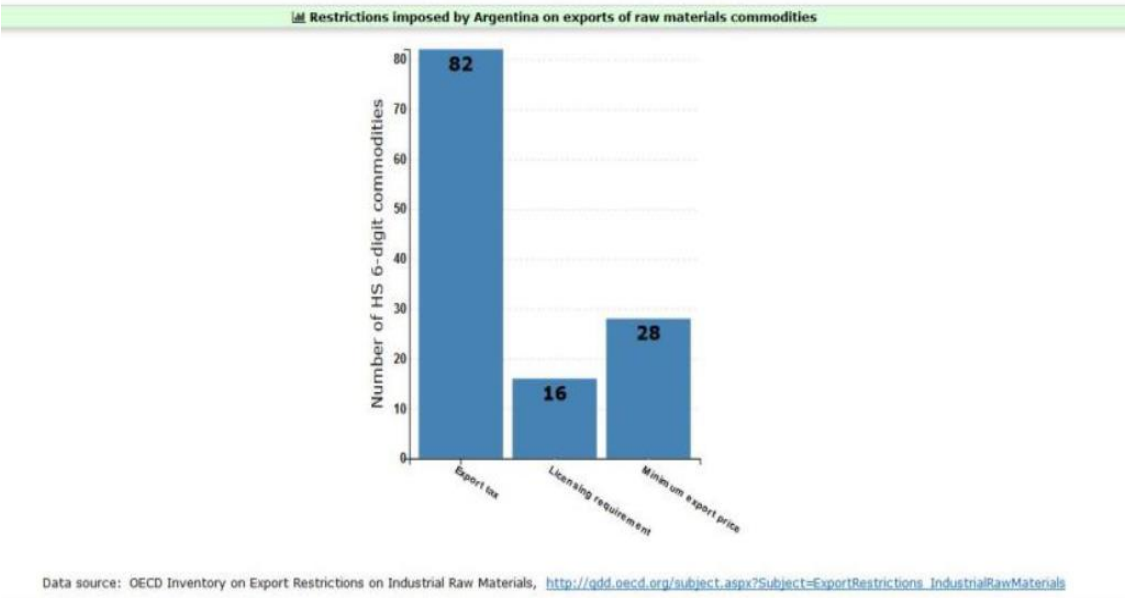
- visualization of top 20 HS non-energy and non-food raw materials commodities exported (monetary value; quantity; calculated share of total raw materials exported; calculated share of total HS commodities exported) – an example is provided below;



- top 10 country destinations of raw material exports - an example is provided below;



- country's restrictions imposed on raw materials exports in place in 2014 (i.e., total number of HS 6-digit raw materials restricted, by restriction type) - an example is provided below.



ii) *Imports of non-energy and non-food raw material commodities in 2014* presents top 20 HS raw materials commodities imported (monetary value; quantity; calculated share of total raw materials imported; calculated share of total HS commodities imported); top 10 source countries of raw material imports; country's tariff profile (work in progress).

The remaining modules of *Country* section, are still under development.

Data coverage

Country section's first module, *Country's raw materials trade*, rests on a database covering 154 countries plus EU-28, and around 825 HS2007 raw materials commodities identified as non-energy, non-food raw materials and intermediate goods. The two selection criteria of commodities at the 6-digit level of HS2007 classification from UNCTAD's two classifications (i.e., SoP1: *UNCTAD-SoP1: Raw materials* and *UNCTAD-SoP21: Intermediate goods*) were: i) primary and intermediate HS 6-digit commodities incorporating minerals, metals and wood and ii) non-food and non-energy commodities. The Harmonize System version employed for this section is HS 2007. The database's time series will be extended in a subsequent stage, by including data for more recent years.

Monetary and quantitative data on trade flows of raw materials and trade partners were extracted from UN Comtrade[35], which is the most comprehensive official public source of goods' trade statistics. These data have been further processed by JRC to produce **country's overviews** of most traded raw material products and country's major import sources and export destinations.

The source of data for country's restricting measures imposed on exports of HS 6-digit raw material commodities in place in 2014 is OECD's dedicated inventory. Inventory of

[35] DESA/UNSD, United Nations Comtrade database.

Restrictions on Exports of Industrial Raw Materials[36]. Based on this dataset, JRC elaborated **country's export restriction profiles**.

In the subsequent stage (foreseen in Q1 of 2018), JRC will develop country's **trade agreement profiles** using data and information provided by World Trade Organisation dedicated datasets[37].

Country's foreign direct investment profiles (i.e., stocks and inward and outward flows) and Trade performance & competitiveness indicators, as well as the entire *Product* module, will be developed in the second stage. This methodological overview will be progressively updated as soon as the referred modules are completed.

[36] OECD Inventory on Export Restrictions on Industrial Raw Materials, http://qdd.oecd.org/subject.aspx?Subject=ExportRestrictions_IndustrialRawMaterials

[37] The databases are WTO's RTA database, which contains regional trade agreements in force by country (http://rtais.wto.org/UI/PublicAllRTAList.aspx) and PTA database, which provides information on WTO countries' preferential trade agreements (http://ptadb.wto.org/ptaList.aspx).

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KJ-NA-28526-EN-N

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doi:10.2760/119971

ISBN 978-92-79-66933-0